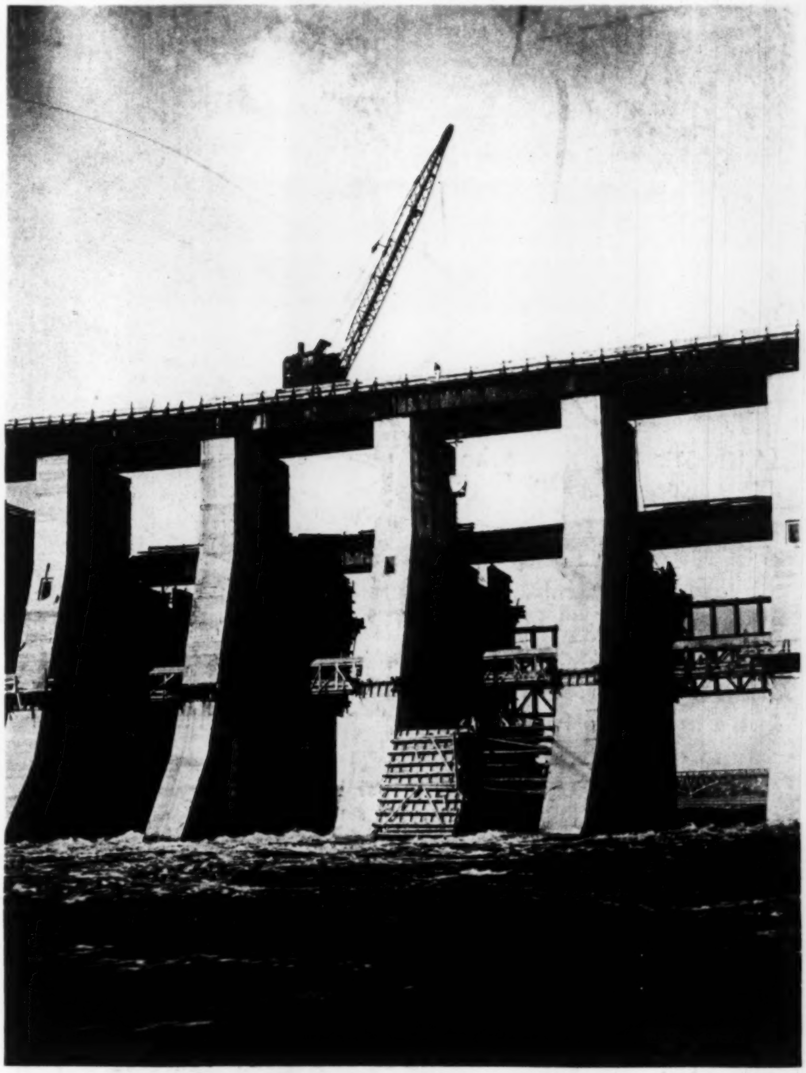
Engineering
News-Record

June 23, 1932

25 cents, $5 per year

McGraw-Hill Publishing Company, Inc.

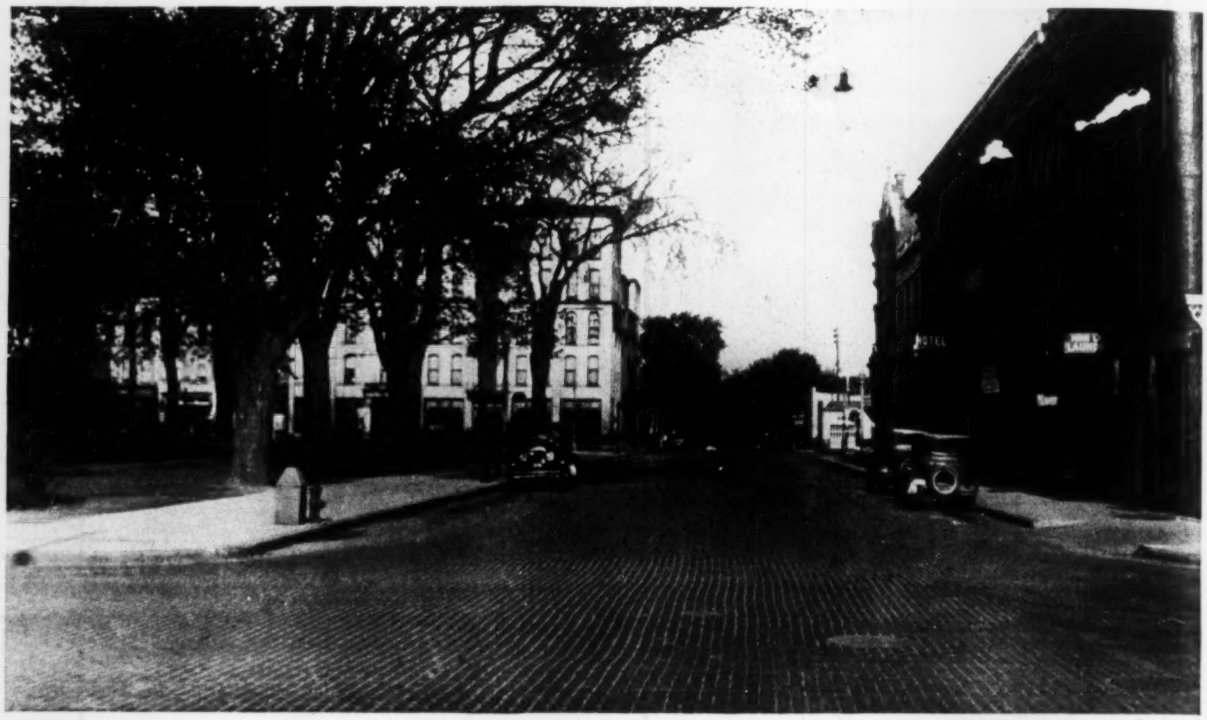
JUN 27 1932



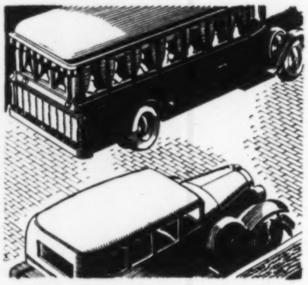
Damming the Dnieper in Russia

● No foreign construction work has held the interest of the American people so completely as the great hydro-electric project, Dnieprostroy, that American engineers and American equipment have built in Russia, using Russian peasant labor. Human problems quite as great as the unprecedented technical ones were encountered. The story of the work in this issue should have universal appeal, for no more dramatic nor instructive construction job has been carried out in modern times.

BRICK CUTS MAINTENANCE COST



Ann Street—Fourth Avenue to Main Street—Ann Arbor, Michigan



ANN STREET in Ann Arbor, Michigan, has served the ever-increasing requirements of a fast-moving age since the turn of the Century. This pavement was laid on sand, with only the subsoil as a base in 1902, and promises to be adequate for a long time to come. There are two reasons for such a record. The first is that subsoil conditions have proven to be remarkably uniform. But fundamentally this record is due to the superior advantages of Brick for paving surfaces. No brick pavement wears out from the top down.

The maintenance cost of this pavement during a period of 30 years has been negligible.

In these times when Engineers and Contractors tell us that "maintenance, repair and resurfacing are given relatively more attention than ever before," freedom from maintenance cost becomes a powerful factor in the selection of paving materials. For this reason: that day and night, in season and out of season the roadways must be kept open so that traffic can go through.

●

THE METROPOLITAN PAVING BRICK CO.
CANTON, OHIO

Manufacturers of Metro Canton, Bessemer, Olean, and Cleveland Paving Block • Architectural Face Brick • Structural Clay Tile • Metro Trickling Filter Flooring •

BRICK PAVEMENTS

Engineering News-Record

Established 1874 ✦ A Weekly Journal of Civil Engineering and Construction Practice ✦ McGraw-Hill Publishing Company, Inc.

F. E. Schmitt, Editor

Volume 108 New York, June 23, 1932 Number 25

Present and Future Questions

REASONING that goes to the heart of the employment problem is presented in the extracts from Willard T. Chevalier's recent address printed in this issue (p. 884). It rests on the well-understood fact that our business system is out of step because of the production glut that followed upon indiscriminate pouring of profits during the boom years into construction of more factories and production equipment. Even now, after nearly three years of progressive shutting down of plants, there is still an excess of both capacity and goods, since unemployment and devaluation diminished the consumer's purchasing power faster than production could be slowed. The road to employment must be found in the face of these conditions. Putting men to work at more production threatens to congest the commodity markets still further. Re-equipping old factories and building new ones will make our industries more topheavy still. But employment in public construction of useful community facilities will restore consumption without these objectionable effects. That is the essential argument for immediate resumption of public construction—a matter discussed from another point of view on the next page. If we look beyond the present, however, the situation outlined by Colonel Chevalier leads into even broader and more difficult questions concerned with the control of unchecked industrial investment. The stability of our economic future is dependent on the financial issues involved.

Engineer Operators

ENGINEERS are to run the new subway system in New York. Under the plan for municipal operations, adopted by the city when no contract operator could be found, the engineers who built the subway will in effect take over its operation. John R. Slattery, the present deputy chief engineer of the Board of Transportation, is to be general manager. Seven years ago, when the construction work was beginning to get heavy, he was called from army service to relieve Robert Ridgway, veteran subway builder, of much of the more arduous field work. The job has been so well done as to promise full success in the difficult task of directing municipal operation of the subway. Colonel Slattery takes with him from the construction forces a number of engineers specially fitted for executive positions in the operating organization and will draw upon that force heavily for the rank and file of the new unit. Skilled operators from existing rapid-transit companies and other railways also have been drafted. The city has not been anxious to take on this task of operating the new subway, for the financial and political problems involved are serious. But since it must enter upon the work, it is fortunate in the able group of men that it has found available as a nucleus of the operating organization. If the subway can be operated successfully as a municipal enterprise, this group should be able to do it. Experience gained in keeping politics out of the construction work will be of value in this new undertaking.

Deep-Earth Sounding

ONE OF the motives for the recent activity in study of soil problems is the realization that we have remained intensely ignorant of the properties and strength of deep-lying soil strata. The foundation builder has heretofore relied wholly on judgment for appraising the supporting power of such strata. He found few tangible facts in the conventional soil soundings and subsoil profiles filled with descriptive notes such as "sandy clay," "fine sand" or "soft blue clay." As data for deciding on permissible load per square foot, such results of "exploration" were little more than riddles, to be solved only by shrewd guessing. Mechanical tests of the subsoil were recognized as desirable, but satisfactory means for making such tests were lacking. Now, in the studies for the proposed San Francisco Bay Bridge, cores of undisturbed soil are being brought to the surface from depths as great as several hundred feet, for measurement of their strength and compressibility in the laboratory. The soil sampler that makes this procedure possible is an interesting development. It yields information that cannot be had from disintegrated or disturbed specimens, whose condition and behavior departs far from that of the soil strata in place, as recent studies have demonstrated. Thus the sampler opens up definite new possibilities in deep-foundation exploration.

Promoting Reinforced Brickwork

GROWING interest in reinforced brickwork, as expressed in numerous recent applications, is an encouraging development, for the introduction of new materials or new forms of old materials has always proved to be a potent influence in bettering engineering technique and in giving the world new resources. The unfamiliarity of American engineers with its possibilities is partly chargeable to lack of interest on the part of the brick industry, which apparently only now is beginning to perceive the possibilities that will open up to it if brick masonry is made a tension as well as a compression material. Since successful promotion of a new construction material requires close and unselfish cooperation of the industry concerned and the engineers who have occasion to apply the material, the brick industry can accomplish valuable results for itself as well as the building arts if it will foster and support a scientific test program and study of the fields of usefulness of reinforced brickwork. There will be little difficulty, we feel sure, in obtaining hearty engineering cooperation.

Public Construction and Private Industry

PROGRESS is at last being made in the efforts to provide employment by resuming normal public construction with the aid of the Reconstruction Finance Corporation. Opposition to these efforts, which succeeded in delaying them for many anxious weeks, has been forced to retreat by the growing threat of bitter distress if unemployment continues unchecked.

A new factor has entered the discussion, however, in the form of proposals to extend public credit to private industry. Some of these proposals were obviously insincere and represented a desire to kill the public-works movement. But others are sincere expressions of a belief that industry aid is essential to speedy reconstruction, and these are entitled to careful consideration.

In appraising the probable value of such aid, it is to be noted first that financial aid to public construction and aid to industry are not essentially in conflict. They are not rival desires for public favor but are inherently cooperative. Either or both will help the revival of business activity in proportion as they restore employment and purchasing power. For example, if one industry can, as it claims, find a hundred million dollars of needed capital-goods production as soon as its clients are able to obtain financing, such a prospect of putting thousands of men to work is undeniably important.

Everyone will agree that industry may fairly ask credit aid for these purposes as long as it is able to offer sound security. The great present test of public benefit is the employment created. It is true that such governmental financing is nothing less than socialization of our industrial organism; for this result the utter failure of the banking system to meet the needs of business must be held responsible. If in the future a modernized banking system is set up, simpler ways of keeping industry at its work may be discovered. But in the present extremity immediate reconstruction is too vital to be blocked by a mere word.

There are some obvious weaknesses in the proposals of government aid to industry. Financing of production is not generally required, for industry needs orders rather than money. Financing of plant expansion or re-equipment, on the other hand, represents a process of increasing further our already-overexpanded productive facilities, and this would intensify many evils from which we now are suffering.

Long-term financing represents the principal difficulty at present. Plant and equipment that require rehabilitation because of obsolescence need something beyond the short-term loans that alone are to be had from banks. Federal monies should not be risked on unsound security, of course, but they may properly and safely be applied to facilitate improvement loans on sound adequate security. For this reason a provision under which banks could rediscount five- or ten-year loans at the R.F.C. would free the banks of their present necessity to accept only liquid paper. A great volume of credit now frozen in the banks would then become effective to stimulate business activity and employment.

It is well, therefore, that such opportunities as private industry can offer for putting credit to work be made available by R.F.C. aid. The chances of creating any large amount of employment in this way without the menace of overexpansion may be very limited, but small as they are they should be taken.

Regardless of industry aid, public-works resumption remains the only sure road to employment, and no bill that fails to provide for it as major reliance for recovery can afford the slightest hope of effective results. With public works as the central point, sound means of assisting private industry to regain its feet are to be welcomed as helpful possibilities in accelerating the employment campaign.

The Significance of Dnieprostroy

STRANGE though it seems that Russia should build the greatest water-power plant in the world—greater in total capacity as well as in unit size than any single hydro-electric station yet built—it is not really strange when one considers the opportunities which that undeveloped country offers, the intense efforts of the Soviet authorities to industrialize their nation, and the fact that the world's accumulated experience and resources were at their command. At Dnieprostroy the experience largely was of American origin, a fact to which the success of the project and many of its major characteristics are due. The huge plant, in fact, represents essentially a normal step forward along the path marked by the great power plants of our own country.

In the physical elements of its design, as well as in the methods employed in its construction, Dnieprostroy thus is so closely allied to power development in this country as to have peculiarly strong appeal to American engineers. They will find much to interest them in the characteristic features of the project described in the article that forms the major subject of this issue. But in its broader aspects, in its relation to the great struggle for attainment of an ideal that is now going on in Russia, the project has perhaps still greater significance, for Dnieprostroy is one of the great objectives of the five-year plan. That it is practically the only major part of the five-year plan that went through on schedule is largely due to American initiative, methods and equipment joined to the strength of purpose of the government leaders and the enthusiasm—or fanaticism, some may say—of all who had a part in the construction operations on the Dnieper River.

Almost no special equipment was used. The American shovels, cranes and hoists, locomotives and cars, drills and other pneumatic equipment that still are serviceable will go elsewhere in Russia for use; already some of the machinery is on its way to the new power and irrigation projects on the Volga. Many Russian laborers and potential construction foremen also have gone through their apprentice years on the project, under American methods and equipment. These facts will have a continuing significance to American engineers and manufacturers, we believe.

Russia, with vast undeveloped resources, is one of the great potential markets for engineering ability and equipment. Other nations have gone farther than we in cultivating that market, and their machines and men have found a place in many of the projects undertaken by the Russian government. But on the Dnieper, at the great hydro-electric development that is one of the show places of the country, American methods and machines succeeded where others failed. Thus, in the general construction field, at least, the products of this country have achieved a position which they should maintain, and which they can maintain if the equity that they have acquired in a great market is not dissipated by neglect.

ENGINEERING NEWS-RECORD—JUNE 23, 1932

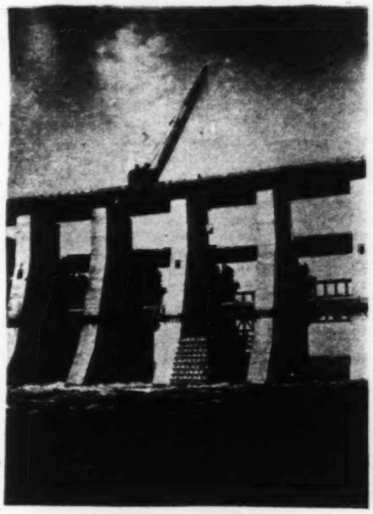
Dnieprostroy in Russia 877
Storm Tests Alexander Dam........ 883
Progress Depends on Construction .. 884
New Sewage-Sludge Vacuum Filter .. 884
Measuring Concrete Consistency 885
Vibration in Tall Buildings........ 886
Plant-Mix Oiled Roads.......... 887
Steel-Plate Floor of New Type...... 889
Clay Sampler for Bridge Borings.... 891
Reinforced-Brick Tank Inclosure..... 892
Mittelland Canal in Germany...... 893
High-Speed Screed Tamper .. 894
Letters to the Editor 895
News of the Week 898

American Methods Win Fight to Control Russian River

A DRAMA unlike that found in any large construction operation in this country is revealed in the record of how Russian laborers, unfamiliar with modern construction equipment, were able to carry through to successful completion and on schedule time the work of building the power and navigation project now nearing completion on the Dnieper River in Russia. American equipment was used and American construction methods were employed in the undertaking; and while this fact in itself is not remarkable, there lies behind it an unusual story of how those methods came to be employed in preference to European methods and of how design and supervision of construction of the project was placed in the hands of an American engineer—Hugh L. Cooper—after both methods had been put to a practical test. The record is one of how sound engineering backed by large experience in damming large rivers won against theory backed by little or no practical experience with like problems.

The Dnieprostroy hydro-electric and navigation project is located in the republic of Ukraine in south-central Russia, at a point on the Dnieper River near Kichkas, about 200 miles above the point where the river discharges into the Black Sea.

The river has been navigable hitherto up to the site of the Dnieprostroy project and again for a considerable distance above. The stretch of the river just above the site of the Dnieprostroy development is a series of rapids, which makes that section of the river unnavigable. The total fall is over 120 ft. in a distance of 180 miles. At Kichkas the river drains an area of about 170,000 square miles, and its flow, according to a 46-year record, ranges from 6,300 to 720,000 sec.-ft. In the great flood of 1931 the flow amounted to 835,000 sec.-ft.



In damming the Dnieper River, piers were first built out across the river, following a method found successful in this country, and then the opening between the piers was closed off during periods of low water.

As far back as the reign of Catherine the Great the construction of a canal and locks around the non-navigable rapids near Kichkas had been considered and plans prepared therefor, but the work was never undertaken.

Early development plans

The history of power development at Kichkas goes back for many years. Just previous to the outbreak of the World War British capitalists who were then considering the development of the power site asked Hugh L. Cooper to examine and report upon it. This examination and study was not made for various reasons. When Russia had settled down after the World War and its subsequent civil wars, the Soviet government authorized the beginning of new studies and extensive surveys for a proposed power development at the same site.

In 1926, after considerable field work and studies had been made by Russian engineers under the direction of Professor Alexandrov, the government decided to engage foreign engineers as consultants for the proposed development. Early in 1926 a commission was appointed to visit Europe and the United States and to select an engineering firm for this work. This commission visited the United States and in 1926 engaged the services of Hugh L. Cooper & Company to investigate the project and to report to the government on its economic and engineering feasibility. The preliminary investigation by Colonel Cooper and his assistants occupied most of the summer of 1926, and upon the conclusion of the investigations a report was rendered to the government stating that the project was feasible from an engineering and economic standpoint.

After the filing of this report with the government a contract was entered into by the government with Hugh L. Cooper & Company for the supervision of the design and construction of the project.

Meanwhile, however, a prominent European engineering firm had been considered for the position of co-consultants, and had submitted an engineering proposal, including design and plans for the construction. The great detail in which this proposal had been worked out so impressed itself upon the technical advisers of the government that, although an agreement had already been made for the planning and supervision of the work, the government, unable to decide which of the two plans they should follow, engaged this firm in the capacity of co-consultants.

Subsequent to the signing of the co-consultant contract, the government decided to call a conference of all their leading engineers and technicians to act as judge as to whether the American plan or the European plans should be adopted.

Two plans differ widely

The quantity of water to be handled during the construction was known to be unprecedented in work of this character. Further, the depth of suitable foundations was unknown, except that the incomplete exploratory work indicated that it might be far below the normal bed of the river. To meet these conditions, the American plan called for the use of the method of river control employed for similar construction in this country, that of building the dam as a series of piers, making provision to pass floods between the piers. This method was originated by Colonel Cooper on the McCall's Ferry work in 1906; also his plans called for timber-crib cofferdams set well back from the line of the dam to provide ample working space should deep excavation be necessary.

The European plan, on the other hand, called for a clearance of only 10 ft. between the permanent work and the inside face of the cofferdams, which consisted of short piers separated by sluiceways, the piers being anchored to the river bottom (assumed to be rock) by H-columns set in 12-in. holes drilled in the rock. Even the details of drill boats had been worked out and were shown on the plans.

Twelve and one-half million metric tons of material had to be moved during construction, and the work had to be carried on by Russian mechanics and laborers who had no previous experience in such large operations. The American plan proposed the simplest and most flexible methods available for moving such vast quantities with unskilled labor. All construction railroads were of standard Russian 5-ft. gage, which the great tonnage to be moved required and with which the laborers were familiar. The track layout was simple, and each unit was made as independent of the others as possible. No complicated equipment was called for.

The European proposal carried mechanization of the work to the other extreme. Excavation of the powerhouse site and the tailrace was to be handled by a single gantry crane of 460-ft. span, and all excavation for the dam itself was to be handled by four gantry cranes having a single hoist each. The construction railroad consisted of an elaborate network of narrow-gage lines so interconnected that a breakdown or derailment at some of the bottlenecks would have tied up much of the system. The two proposals throughout were striking in their dissimilarity.

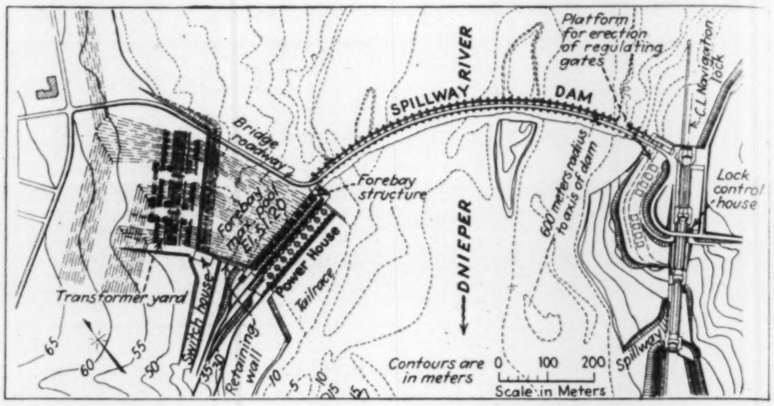
The technical advisers of the government could not agree as to the adoption of the American plan or the European plan but were unanimous that the two plans could not be integrated and that one or the other had to be accepted in its entirety.

Both methods tried

After long deliberation a compromise decision was announced, stating that the American plan would be tried out on one side of the river and the European on the other, until such time as one had demonstrated its superiority in practical test. Actual physical work on the project began in the spring of 1927. Before the summer of that year was over the American plan had proved its practicability, whereas it had been fully demonstrated that the European plan was impossible of achievement, and it was decided to adopt the American plan in its entirety for all the design and construction operations.

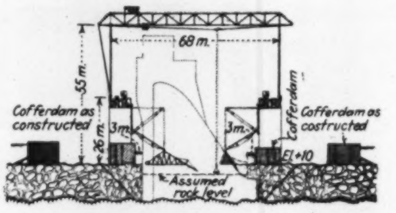
Quantity of power produced

Discharge records of the Dnieper River were continuously kept during the 46-year period 1878 to 1923; and in 1926 Cooper's check-up was made by using additional river gagings, and the accuracy of the records was established, indicating a variation in the daily flow from a minimum of 6,300 sec.-ft. in two specially dry years to a maximum of 720,000 sec.-ft. As has previously been mentioned, a maximum discharge of 835,000 sec.-ft. was recorded in May, 1931.

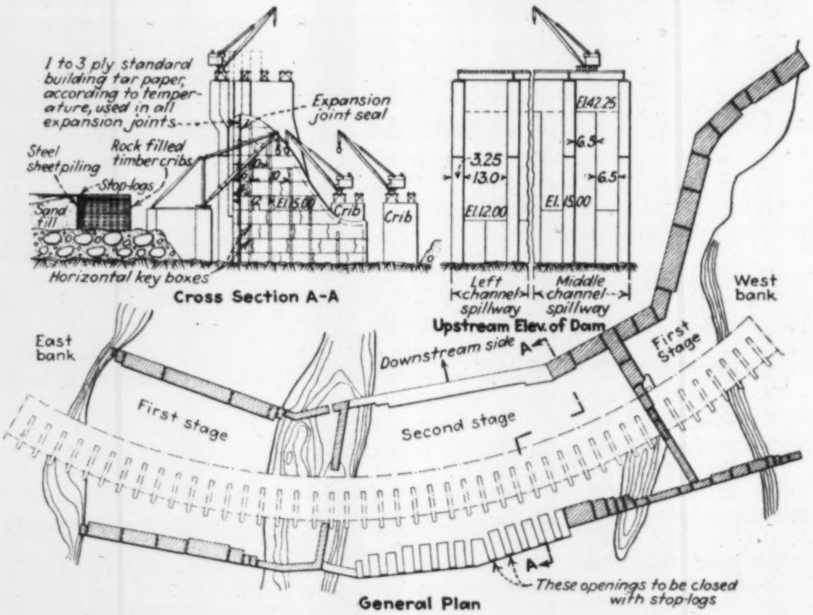

Platform for erection of regulating gates
RIVER
SPILLWAY
DAM
R. C.L Navigation lock
Bridge roadway
Forebay structure
Forebay max. pool El. 51.20
Lock control house
DNIEPER
600 meters radius to axis of dam
Transformer yard
Switch house
Power House
Tailrace
Retaining wall
65
60
55
50
35
30
10
5
10
15
15
Contours are in meters
0 100 200
Scale in Meters
Spillway

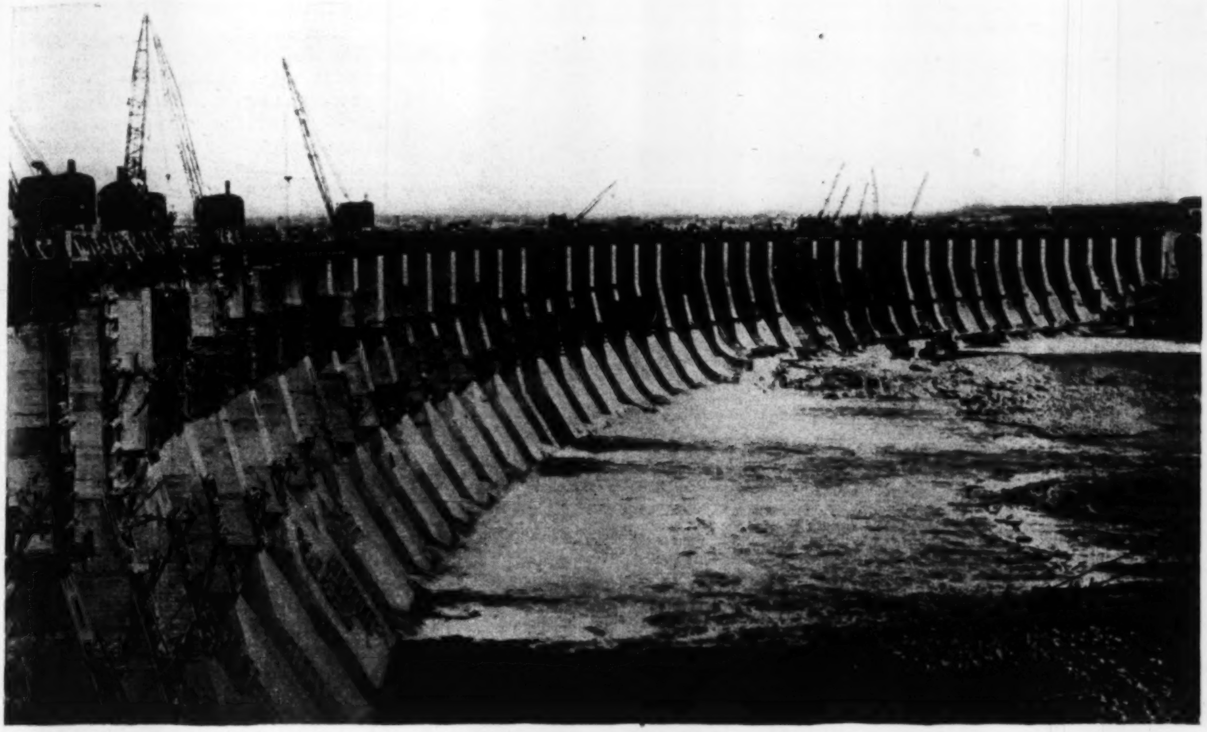
The Dnieprostroy project includes a curved dam with 2,000 ft. of spillway, a power house for nine turbines of 84,000 hp. each and three navigation locks.

The European plan of construction called for four gantry cranes to serve the dam. They were mounted on cofferdams placed within the area that had to be excavated to reach solid rock.


68m.
55m.
Cofferdam as constructed
3m.
26m.
3m.
Cofferdam
Cofferdam as costructed
El+10
Assumed rock level

The construction layout was made as simple and flexible as possible. The cofferdams were set well back from the dam to provide for the possibility of deepening the excavation.


1 to 3 ply standard building tar paper, according to temperature, used in all expansion joints
Expansion joint seal
Steel sheetpiling
Rock filled timber cribs
Stop-logs
Sand fill
El. 15.00
Crib
Crib
Horizontal key boxes
Cross Section A-A
El. 42.25
6.5
6.5
3.25
13.0
El. 12.00
El. 15.00
Left channel spillway
Middle channel spillway
Upstream Elev. of Dam
East bank
West bank
Downstream side
A
First stage
Second stage
First Stage
A
These openings to be closed with stop-logs
General Plan



During the summer of 1931, when the water was low, the opening between the piers of the mid-channel section, which had successfully passed the great flood of that spring, were closed off.

In deciding the generating capacity that should be installed the following determinative factors were taken into consideration:

a—The probable load factor that will be developed for the use of the power.

b—The cost of steam power in the territory.

c—The unit cost of the hydro-electric installation.

d—The use of the storage capacity of the reservoir behind the dam, amounting to 39,000,000,000 cu.ft. for a 20-ft. drawdown of the pool.

e—The intended use of the power, the major part of which the Soviet government will devote to the production and manufacture of ferrous and non-ferrous metals in the vicinity of the power site.

An installation of nine units, each of 84,000 hp. rated capacity at average head, was thus determined upon, a total for the station of 756,000 hp.

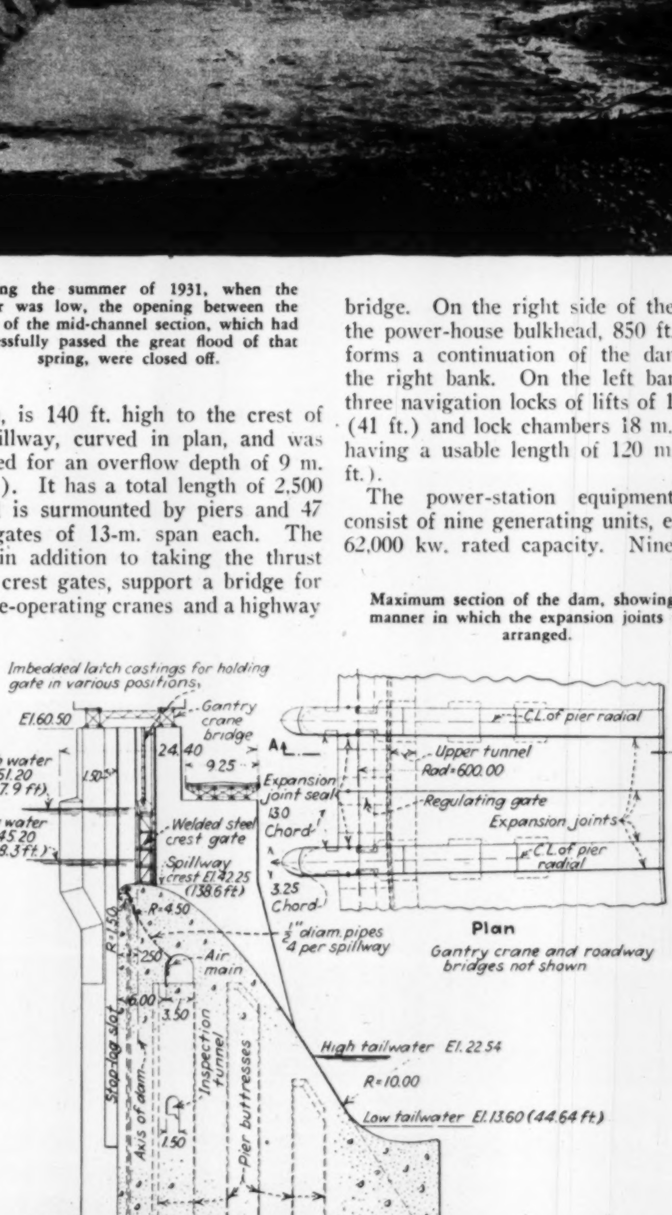
On the basis of the above installed capacity and of river discharges available, as previously recorded, the station will have an average annual production of 2,520,000,000 kw.-hr., of which 1,300,000,000 will be primary power and the remaining 1,220,000,000 secondary power, to be backed up later by steam as market demands require. It is planned to make the Dnieper development the center of a vast super-power system for south Ukraine.

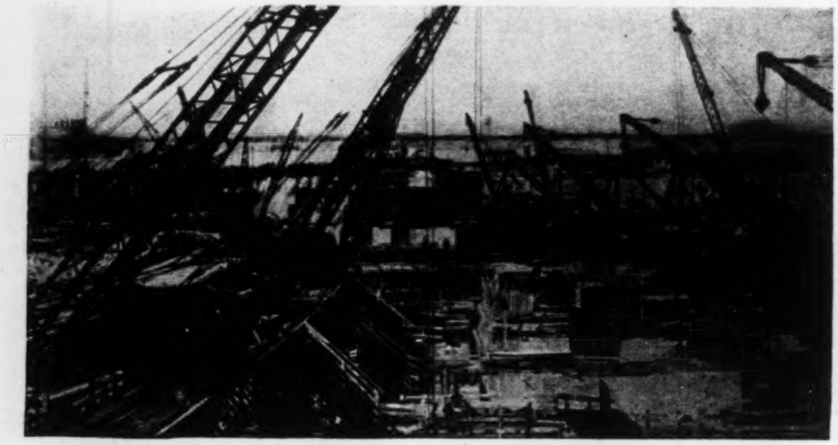
General description of project

The development is shown in the accompanying drawings and photographs. The main dam, extending entirely across the river channel, is of gravity section, is 140 ft. high to the crest of the spillway, curved in plan, and was designed for an overflow depth of 9 m. (30 ft.). It has a total length of 2,500 ft. and is surmounted by piers and 47 crest gates of 13-m. span each. The piers, in addition to taking the thrust of the crest gates, support a bridge for the gate-operating cranes and a highway bridge. On the right side of the river the power-house bulkhead, 850 ft. long, forms a continuation of the dam into the right bank. On the left bank are three navigation locks of lifts of 12.5 m. (41 ft.) and lock chambers 18 m. wide, having a usable length of 120 m. (394 ft.).

The power-station equipment will consist of nine generating units, each of 62,000 kw. rated capacity. Nine com-

Maximum section of the dam, showing the manner in which the expansion joints were arranged.


Imbedded latch castings for holding gate in various positions
Gantry crane bridge
El.60.50
24.40
9.25
A
High water El. 51.20 (167.9 ft.)
1.50
Low water El. 45.20 (148.3 ft.)
Expansion joint seal
1.30 Chord
Welded steel crest gate
Spillway crest El. 42.25 (138.6 ft.)
3.25 Chord
R=4.50
R=1.50
½" diam. pipes 4 per spillway
2.50
Air main
6.00
3.50
Stop-log slot
Axis of dam
Inspection tunnel
Pier buttresses
High tailwater El. 22.54
R=10.00
Low tailwater El. 13.60 (44.64 ft.)
1.50
El.0.00
38.00 (124.6 ft.)
3
Cross Section A-A
C.L. of pier radial
Upper tunnel Rad=600.00
Regulating gate
Expansion joints
C.L. of pier radial
A
Plan
Gantry crane and roadway bridges not shown



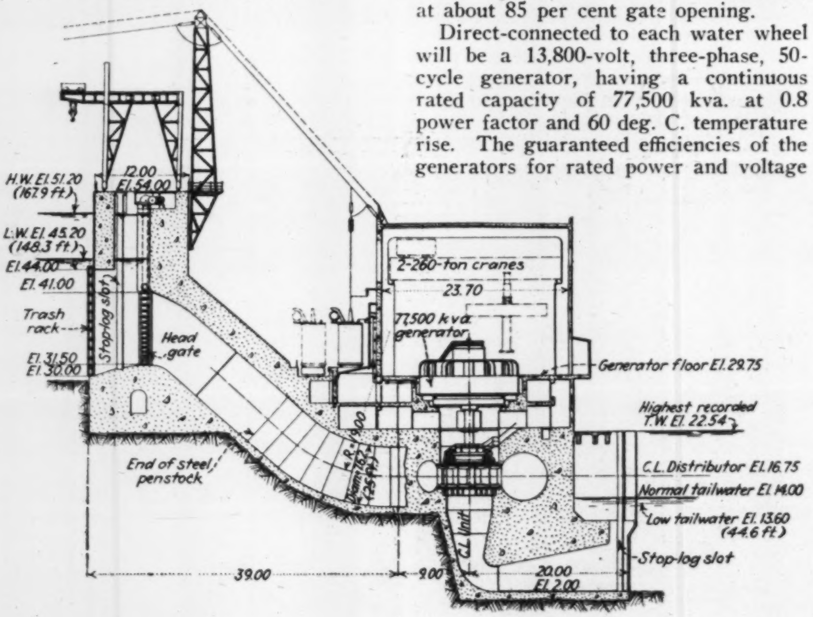
Once the mid-channel cofferdams were closed the maximum amount of equipment was concentrated upon getting the piers built to above the level of high water before the spring flood.

plete turbines manufactured in this country are now being installed, and five generators built in the United States and one built in the Soviet Union are also in process of installation.

The generating units are the largest in physical size and capacity ever built and include the latest and most up-to-date features known in American design and manufacture of hydro-electric machinery.

The water wheels of the hydraulic turbines are of standard Francis type and will develop 84,000 hp. under a normal gross head of 116.5 ft., and more than 100,000 hp. under a maximum head of 123 ft., operating at 88.2 r.p.m. Each runner is of cast steel, made in three sections securely held together by steel shrink bands and bolted and doweled to a cast-steel runner hub. The runner weighs 160 tons, and its largest diameter measures 19 ft. 10½ in.

The power house in its general arrangement follows current practice in this country. Ultimately it will contain nine turbines of 84,000 hp. each.



The penstock and scroll case of the turbine are of plate steel and, except for their large dimensions, are of conventional design. They are entirely embedded in concrete, except that a thin space has been left between the overlying concrete and the steel plates of the top half of the scroll case to facilitate "breathing" under variations in internal pressure. This space was created by coating the upper halves of the casings with felt, ¾ in. thick, before the concrete was deposited.

The draft tube is of the modified elbow type formed in concrete and lined with plate steel at the upper end.

The turbines are guaranteed by the manufacturer to operate at an over-all efficiency of 90.6 per cent through a range of 67,000 to 91,000 hp. under a gross head of 116.5 ft. and an operating speed of 88.2 r.p.m.; and also to deliver 84,000 hp. under these same conditions at about 85 per cent gate opening.

Direct-connected to each water wheel will be a 13,800-volt, three-phase, 50-cycle generator, having a continuous rated capacity of 77,500 kva. at 0.8 power factor and 60 deg. C. temperature rise. The guaranteed efficiencies of the generators for rated power and voltage are 97.8 per cent at full load and 96.8 per cent at half load.

The framing of the generator is of welded steel construction, with the thrust bearing mounted above. This bearing is of the spring type and designed to support a load of 2,000,000 lb., which is the total weight of the generator rotor, the 41-in. diameter, 58-ft.-long shaft, the water wheel and the reaction of the water.

The power-house superstructure, in architectural design, departs from the usual American practice. It is of steel and reinforced concrete of a design developed by Russian engineers as a standard for their power plants.

Provisions for ice control

Provisions have been made to protect the power station from the heavy ice flow that passes down the river in the spring of each year. Such ice and floating material as comes down the river will be excluded from the forebay by skimmers attached to the piers carrying the highway from the dam across the forebay. Heavy ice accumulations around the crest gates on the dam will be prevented by discharging compressed air from outlets installed along the crest of the dam.

Construction equipment

As a result of the adoption of the American plan for the construction of the Dnieprostroy work, American manufacturers of construction equipment were called upon to furnish this project with various classes of construction tools, including 27 locomotive cranes, four electric shovels of 4-cu.yd. and six steam shovels of 2-cu. yd. capacity. 71 dump cars of 5-ft. Russian gage, 1,500 tons of sheetpiling, sixteen derricks—some of which were stiff-leg and some guy derricks—many standard well drills, a large amount of compressed-air equipment and drills, totaling altogether around $3,500,000 in cost.

In the selection of all of this equipment a special study was made regarding the usefulness of the equipment on other jobs after the Dnieprostroy work would be completed. The actual performance of all this construction equipment, notwithstanding the particularly rough usage it underwent during the educational period when operators were being taught to use the apparatus, resulted in a fine victory for the American construction apparatus. Colonel Cooper states that the records that have been made on this work were only possible because of the construction equipment was strong and well designed.

The rock-crushing machinery and the revolving-drum concrete mixers were supplied by Germany. The quality of the rock to be handled by the rock crushers was of great density and difficult to crush; and whereas at the beginning of the work the usual number of breakages occurred in the rock-crushing plant, these were all finally overcome, and the performance of the crushers was satisfactory.

The concrete mixers were well designed, well manufactured and did their work satisfactorily.

A very well-constructed machine shop, for the repair of all classes of construction equipment, had also to be provided.

The construction power unit was provided by the use of a steam plant that had seen service elsewhere in Russia, the capacity of this plant being about 10,000 kw.

In the initial use of the heavy construction equipment sent from America, the expected difficulties incident to inexperience were encountered. Patience in the work of instruction had to be exercised by everyone, but in a surprisingly short period the operators began to show good results, so that after 1 to 1½ years of experience the different machine operators could be depended upon for a fair day's performance.

Construction operations

The construction program was laid out to cover four seasons. In the first season the cofferdams were built out into the river for the two end sections of the dam and for the power house, restricting the river to mid-channel. Within the cofferdams the piers were built up above high water and the foundations of the spillway sections were laid. During the first spring flood the cofferdams were overtopped; but as this had been anticipated, no damage occurred.

The following season piers of stone-filled cribs were built out across the center channel, and when the river could be diverted through one of the end cofferdams, passing between the permanent piers of the dam, the mid-channel was closed off with stop-logs placed between the crib piers, and the lower cofferdam was completed.

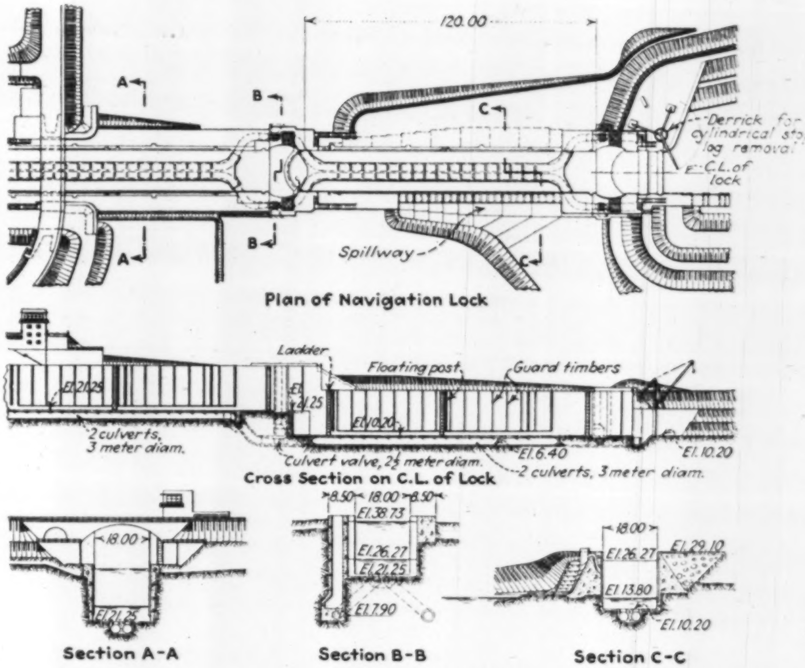
By the spring of 1931 the piers of the mid-channel section had been built up to above high water, and the foundations of the intervening spillway sections had been laid, so that when the great flood of that season came no damage either to permanent or temporary construction was sustained.

The cofferdams used were built up of 9x9-in. timbers, the largest size available, and were filled with rock, sheeted on the water face with steel sheetpiling and made tight by a bank of sand pumped in against the sheetpiling from the adjacent riverbed.

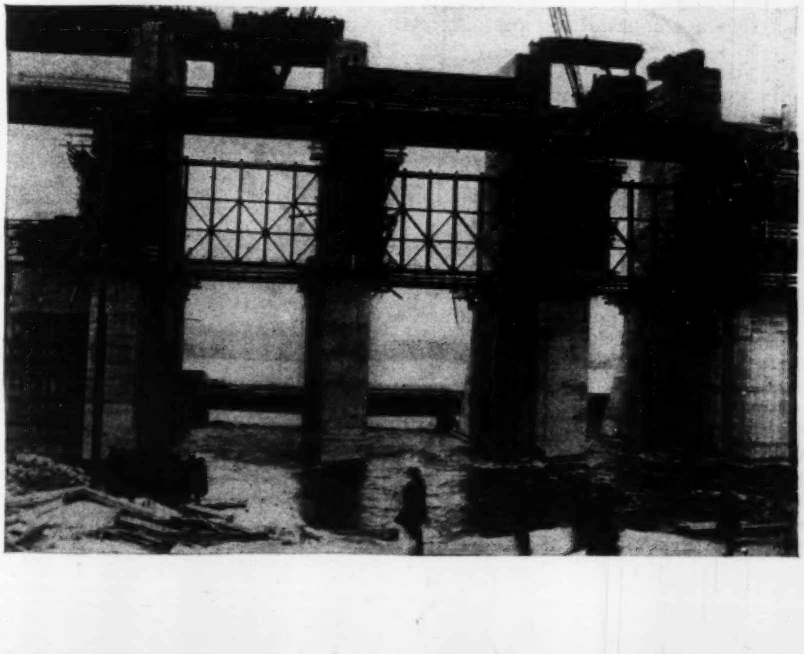
Deep excavation required

The original Russian studies of the site reported solid rock to be close to the surface in the river bottom. The examination of the site (at the foot of a long rapids where rock was exposed) that Colonel Cooper had made in 1926 led him to assume that this information was inaccurate, that the bottom was filled with debris washed down from the rapids, in which the boulders were of such size as to indicate solid rock in any method of sounding, except by drilling. For this reason he set the cofferdams well back from the dam in order to have ample working space, should rock not be found close to the surface. This assumption as to foundation conditions proved correct; in certain sections, for example, solid rock was not found until 50 ft. below the top of the cofferdam.

The construction railrods serving the dam were carried out across the river on deck-plate-girder bridges set on the cofferdams or on timber-crib pier. Plate girders of 53-ft. span were used because plans for the finished dam called for two deck bridges, one for the highway and one for a craneway. By designing these bridges as plate girders and having the steelwork fabricated and delivered at the start of the undertaking for use during construction, a considerable saving was made in construction costs and in time. The manner in which these spans

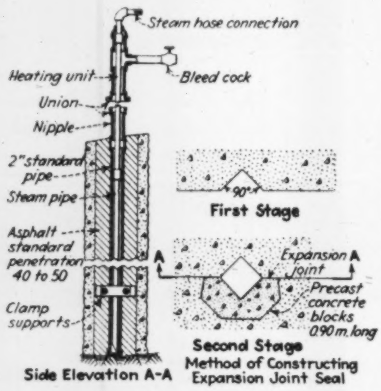


Three locks of 41-ft. lift are located on the left bank. Two are shown here.



The girders that form the permanent bridges on top of the dam served first as bridges spanning openings in the cofferdam (beyond the piers) and then by progressive steps served for construction operations as the dam went up, locomotive cranes transferring them easily from place to place. Suspended in the openings between the piers are frames for the temporary gates to close off the bypass channels.

Women did everything that the men did and generally more efficiently. These women are concrete workers waiting for their shift.



The expansion joints are closed with seals designed to provide a tight joint under the maximum range of temperatures.

were used as temporary bridges throughout the operation is shown in the accompanying illustrations.

Concrete work

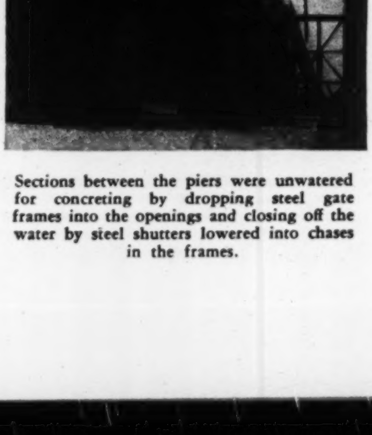
Rock-crushing and concrete-mixing equipment, as noted previously, was of German manufacture. Ample sound rock was available for coarse aggregate, much of it being a good quality granite removed in excavating the foundations. Fine aggregates, in the original planning of the Russian engineers, were to have been obtained by crushing the granite, but this did not prove satisfactory, and little fine crushed material was used. For most of the concrete a clean sea sand was brought in over a distance of 200 miles.

Concrete was mixed stiff, using Colonel Cooper's well-known specification for consistency—namely, that workmen must not sink into the fresh concrete over their shoe tops. Cement was of Russian manufacture, tested in laboratories in the United States, and proved to be of high quality and uniform strength. Laboratory control of all concrete was established on the job.

All concrete was placed from bottom-dump buckets hauled to the job on flat car and swung to position by derricks or locomotive cranes. In placing the mass concrete the blocks of fresh concrete were limited to length not exceeding 12 m. (10 m. generally) and a depth of 4 m. This was done to reduce the heat generated in setting and to limit shrinkage. Large keyways, both vertical and horizontal, were provided. Buttresses, on the sides of the pier sections of the dam, cast integral with the piers, as indicated in the drawings, provided adequate bond across the expansion joints between the piers and spillway sections. All expansion joints now are closed off at their upstream end by a water seal.

A total of 1,600,000 cu.yd. of concrete will ultimately be placed in the dam, power house and navigation works. In the concreting season of 1930 the Dnieprostroy organization deposited 725,000 cu.yd. of concrete, 650,000 cu.yd. of which was deposited in the dam and power house, thus exceeding any previous rate of concrete depositing in the history of work of this character. This great result was accomplished by a supreme effort on the part of the entire personnel of the organization, even office employees voluntarily giving many hours of their free time to help.

Recesses were cast into the sides of the piers, above the upstream face of the spillway sections, to support steel closure gates installed temporarily to permit concrete to be deposited in the lower part of the spillway sections. Closure was accomplished by first lowering the gate frame into place and then dropping narrow shutters into slots in the frame, slowly cutting off the river flow. The remaining leakage was handled by a small pump within the construction gate. Provision was made for closing off either a whole or half section of the spillways.



Sections between the piers were unwatered for concreting by dropping steel gate frames into the openings and closing off the water by steel shutters lowered into chases in the frames.

Foundation grouting

The foundation rock of the dam is hard granite of high density and very suitable for foundation purposes.

Grouting of the dam foundation was carried out extensively and with great care, the object being to produce a continuous and watertight diaphragm wall under the upstream portion of the entire dam and power-house bulkhead.

When the foundation rock was first exposed, a series of 3-in. holes 8 m. deep was grouted to close off surface seams. Subsequently, after a considerable weight of concrete had been placed on the rock, a line of 6-in. well drill-holes, 3½ m. apart, were drilled 30 m. into rock and then tested and grouted. A second set of holes located on the same line and midway between the first set of holes, was then drilled, tested and grouted. Satisfactory results, as indicated by special test holes, were usually obtained after this procedure, and if not, additional grout holes were drilled where found required.

A total of 15 miles of holes was drilled to prepare the foundation of all structures, and some 600 metric tons of cement was forced into the foundation rock.

Labor problems

As was to be expected on a project of this magnitude, among the first sets of plans worked out were those for the care of the labor that was to build the project. The Russian engineers rebuilt the city of Old Kichkas and designed the new buildings for the housing of labor and for their feeding and entertainment. The new city takes care of a population of about 25,000 at the peak. Part of the workmen lived there, and the remainder lived in camps on the other bank. During 1928 and 1929 the average number of workmen was close to 9,000, but beginning early in 1930 the number increased until it reached a peak of 25,000 late in 1931, when every effort was being directed toward being ready for the spring flood in 1932.

The feeding of this army of workers was accomplished by the use of large kitchens and small restaurants and by workers supplying their own food. The housing arrangements for the labor were substantially better than similar average arrangements on American construction work.

All the construction houses for the workmen were supplied with electric light and running water. The camp also included club houses and cinemas for the comfort of the workers, and they always seemed to be very well patronized.

The popular notion in America that labor is forced in Russia was found to be 100 per cent erroneous. The laborers were at all times free to change their places on the job or to leave the job

Hugh L. Cooper, directing head of the organization, more at home in the bottom of a cofferdam in the middle of a river than in his office on Park Ave., New York.

entirely for other work that they believed was more attractive.

As a result, the labor turnover provided one of the major problems of the undertaking. Labor in Russia since the war has been nomadic and the turnover enormous, judged by American standards. For this reason special efforts were made to keep the labor satisfied by providing the best possible housing and living conditions, but notwithstanding these efforts the annual turnover at Dnieprostroy approximated 60 per cent of the total number employed. There was a constant shift from one department of the work to another by labor and an almost continuous migration between the farms and the project. It was not unusual for a whole group of two or three hundred men to leave the project simultaneously in the midst of important operations, their sole reasons being that they had heard that food was better on some other job or the pay more liberal, and furthermore that they were interested in seeing some of the other great developments they had been hearing and reading about.

Contrary to the accepted idea in this country, the pay of Russian labor varies widely. After much persuasion, piecework pay was adopted on the Dnieprostroy project. For example, the concrete workers were paid on the basis of the number of buckets placed in the forms per shift. The amounts paid or changes in rates resulted in endless discussions in the early part of the work; but as the project progressed, the rate question was adjusted much the same as in the United States, by negotiations between labor and administrators on the job.

For the most part the labor was farm labor from near-by villages, wholly unaccustomed to the operation of machinery, so that a period of instruction had to be conducted before this labor could become either skilled or semi-skilled.

Many women worked on the job, performing such roles as instrument workers using transits and levels for concrete forms, forewomen, machine operators, locomotive firewomen, switch tenders, concrete placers and common labor. These women, contrary to all expectations, were exceptionally efficient. It was not unusual to see a woman continue her work for half an hour after the whistle blew for the end of her shift, in order to finish perfectly a task on which she had been working.

The work was carried on in three shifts of 7½ hours each. Foremen were trained from among the workers.

Administration

Hugh L. Cooper & Company maintained a staff of American engineers on the job to develop the details of the engineering plans and to see that they were understood and properly carried out. The field direction of the work for the company was under the direction of Milton T. Thompson, with J. W. Hall, F. P. Fifer, L. G. Puls, J. W. Johnson and H. B. Wilkinson as his assistants.

In addition to this staff, the Newport News Shipbuilding & Dry Dock Co. and the General Electric Co. supplied a force of American engineers and mechanics for service in connection with the erection of the turbines and electric generators in the power house.

Rockwell Smith was chief concrete inspector, with F. C. Shoemaker and J. D. Flagg as his principal assistants.

The Russian directing organization was known as the Dnieprostroy Administration. At the head of the Dnieprostroy Administration was A. V. Winter, who had as his first assistant B. E. Vedeneev, and, during the period of maximum construction, P. P. Rotert. Work on the right bank of the river was under the direction of I. Kandaloff, and George Vecelago was in charge of left-bank operations.

The Dnieprostroy Administration reported directly to the Supreme Council of National Economy, under whose direction the whole undertaking was administered. V. V. Kuybysheff and G. K. Orjonikidze were the directing authorities of the Supreme Council of National Economy, and V. M. Michailoff represented the Supreme Council of National Economy on the project.

The work done by the Russian engineering personnel and all of the labor units won the admiration and respect of the American engineers.

Hawaiian Storm Produces Flood of 5,400 Sec.-Ft. Per Square Mile

A REMARKABLE flood of 5,400 sec.-ft. per square mile from the 2.35 square mile of watershed area above the recently completed Alexander dam resulted from a storm of unusual intensity on the island of Kauai, the most northerly of the Hawaiian group, according to data received from J. B. Cox, engineer in charge of the dam. During the month of February, 1932, exceptionally heavy precipitation occurred on the island, with several rainfall stations reporting more than 50 in. for the month. The record rainfall occurred on Feb. 12, which produced the runoff record from the upper watershed of the small stream. Three raingage records are available, one at the lower boundary of the watershed, where 5.60 in. of rain fell in 24 hours, a second on the easterly boundary of the watershed were 17.00 in. fell between the 9th and the 13th of the month, and a third on the stream about half a mile above the lower boundary of the catchment area, where approximately 17 in. of rain fell in a 5-hour period. However, none of these rain gages was located in the region of most intense rainfall, which was on the western slope of the watershed.

As a result of this rain, the discharge from the 2.35 square mile of watershed reached a peak of 12,750 sec-ft., or 5,400 sec.-ft. per square mile, which is equivalent to 8.35 in. of runoff from the watershed per hour. The total runoff for the day was 523.1 m.g. The average flow of this stream is 15 sec.-ft., with a minimum flow of about 1 sec.-ft. Plotting the flood discharge on Jarvis' chart of floodflows (*Transactions*, American Society of Civil Engineers, Vol. 89, 1926, p. 994), it is found to exceed any record for a similar area, and its volume (in second-feet of 8,300 times the square root of the area in square miles) approaches the maximum line of the chart.

The Alexander dam had been completed, and the reservoir, which has the same catchment area, had been placed in operation two months before the storm. The peak of the flood occurred before the water in the reservoir reached spillway level, and readings on the water level in the reservoir at 10-min. intervals produced an accurate volumetric reading for the stream-gage station. For this reason the figures are known to have more than usual accuracy as a flood gage. The extreme flood was an unusual test of the dam, spillway and outlet structures.

Why Progress Depends on Construction

Construction, the world's capital-fixing agency, viewed as a direct expression of public faith in the future—Its relation to governmental finance and public works

By Willard T. Chevalier
Publishing Director Engineering News-Record, New York, N. Y.

Fundamental principles expressing the function of the construction industry and its relation to business and public welfare were set forth in Colonel Chevalier's address to the Detroit Building Congress on May 27, 1932, of which the following reproduces the most essential elements. —Editor.

What does the construction industry mean to the general business of the land, and what can its integration accomplish for the health of the industry through its influence upon the general community? To appraise these questions, it is necessary for us to see construction activity very clearly in its vital role as the capital-fixing function of our economic scheme.

Day in and day out, year in and year out, the construction industry is engaged in drawing upon the surplus earnings of our industry to fix them in the additional facilities for production and service that are demanded by our advancing standards of life. This is a peculiarly vital function. Not only is it vast and far-flung in its scope, aggregating several billions of dollars annually and touching the life of every state, county, city and hamlet; even more important is its paramount influence upon that exceedingly important flow of our surplus earnings into capital investment on the one hand and consumer buying power on the other.

Our general progress is intimately and inseparably tied up with the progress of the construction industry, for it is that industry that is peculiarly the handmaiden of our faith in the future of our country. When men have faith, they pledge their treasure in the facilities of production and service. When they despair, they withhold this fructifying wealth. Caution replaces enterprise, and security supplants risk; and both enterprise and risk are the essentials of progress.

Under the burden of reduced earnings and declining prices the business man has become restive and impatient of the high cost of government. He is demanding a reduction of taxes in keeping with the decline in his earnings. As a result of this there has been a tendency to slash ruthlessly at the public-works programs of the nation, the states, the counties and the cities, and to resist any effort to expand them.

Every taxpayer must sympathize with these appeals. Yet there is need here to discriminate. Balance our public budgets we must, in order to conserve the public credit, and the way to balance is to reduce expenses rather than to increase tax revenues. But in so doing we must discriminate between the operating budget and capital account. It is not good business to let our operating expenses run beyond our current income, but high economic authority is available to justify a policy of government borrowing in time of depression, to be repaid by taxation upon the surplus earnings of restored prosperity. Such a policy not only adds to the public wealth during a period of low costs, it not only provides employment for millions while private industry may be handicapped, but, what is perhaps more important, it releases a consuming power in the community that is not balanced by a corresponding production of goods that must be absorbed.

Some day, and it may be sooner than we think, we shall be forced to restudy and reform our entire system of governmental finance and taxation in order that our public-works programs may assume a more important role in the stabilization of our industry. There are those of high standing in economic thought who consider such a reform vital to the continued stability of the capitalistic system in this country. They tell us that, if we are to survive, we must find a way to curb the excessive multiplication of our private productive facilities and divert more and more of our surplus earnings into the channels of consumption. They point to investment in community facilities as the sound and profitable means to this end. A system of taxation and public finance that would curb the present untrammeled flow of our surplus earnings into private investment and divert more of them into our public works and community facilities would accomplish this.

It would restrict the vast sums that in periods of prosperity can find their only outlet in multiplying the facilities of production and in wildcat speculation. Such excessive investment in capital facilities leads to the excessive capacity that is found in so many of our industries and has much to do with the advent of depression, which in turn destroys the value of that capital, with shocking loss to the business community and the public welfare.

The individual or the business cannot continue to spend beyond his revenues and survive. So, while private enterprise must economize as a matter of survival, the spending can come only through community effort. Those who favor an expanded program of public works tell us, then, that as a community we should start the ball of investment upon which our revival must depend.

This is where the issue stands today, and it appears certain that some form of public-works activity is to become a part of the governmental program for business revival. The issue has narrowed down from the question of whether or not we should have an expanded program of public works to one of ways and means for providing it.

New Type Sewage-Sludge Vacuum Filter Tested

Recently the bureau of sewers of Baltimore has been conducting dewatering experiments upon ripe digested sludge with a pilot-scale, oscillating, continuous-type vacuum filter. The filter, known as the Genter type, is described by Abel Wolman, chief engineer, Maryland state department of health, in his 1931 annual report as follows:

The filter consists essentially of individual tubular elements arranged in squirrel-cage fashion about a central shaft. The squirrel-cage construction is open at one end. The cantilever elements forming bars of the squirrel cage act not only as filter elements but also as oscillating, agitating arms as they work their way progressively through the sludge bath contained in a tank into which the elements are submerged. A gear-driven mechanism oscillates the central shaft and elements in a progressive manner around a complete circle. Speeds of oscillation and advance are adjustable to the character of the material. The tubular elements are clamped at one end to a spider containing the filtrate conduits that lead to a rotary valve at one end of the central shaft. This valve controls automatically the application and cessation of suction on the tubes entering submergence and leaving the drying arc and then permits the application of atmospheric or low-pressure air to discharge the cake.

The experimental unit used in the tests had a filter area of about 18 sq.ft. and consisted of 80-mesh phosphor bronze. Ferric chloride was used as a coagulant at a pH of 4.8. The moisture of the dried sludge was in the neighborhood of 75 per cent. The pH of the digested sludge before treatment was about 6.9 and filter effluent about 6.3.

There are as yet no commercial installations of the equipment.

Efficiency of Concrete Mixing Recorded by Wattmeter

Placed on power line to mixer, instrument gives precise record of mixer operation and indicates possibility of checking consistency by mixer power requirements

By Ira A. Butcher
Brooklyn, N. Y.; Formerly Construction Superintendent, E. B. Eddy Co.

IN CONSTRUCTING a water-filtration plant for the E. B. Eddy Co., Ltd., of Hull, Que., in 1931, a problem of making watertight thin concrete walls against a hydrostatic head of 24 ft. confronted the contractor. The use of an integral waterproofing was given consideration, but it was decided that watertight concrete could be made without the use of such materials, and that their expense was not warranted, in this case at least. The results justified the conclusions.

The walls were 12 in. thick at the top, 28 in. thick at the bottom and 28 ft. high, some being battered on one face and some on both faces. All were heavily reinforced on both sides with bent vertical steel bars spaced 6 to 7 in. on centers and by horizontal temperature steel placed near the face on both sides.

The concrete equipment consisted of a 1-cu.yd. electric-driven mixer, tower bucket and hoist, buggies for handling the concrete and wheelbarrows, and a skip car for charging the mixer. The control equipment consisted of two ordinary platform scales, large enough to hold a wheelbarrow, on which all sand and stone was weighed, one scale being used for sand and the other for stone, so that it would not be necessary to change the poise when weighing; a set of 8-lb. postal scales weighing to $\frac{1}{16}$ oz.; a set of sieves from No. 4 to 100 mesh; a few graduated clear 12-oz. bottles; some pie pans in which to dry aggregate; some wood alcohol for quick-drying the aggregate; and potassium hydroxide for testing the sand for organic matter. Test cylinders were cast in paper molds.

In recognition of the importance of thorough mixing it was decided that the minimum mixing time should be not less than 2 min.; and to make certain that each batch had its allotted time, a graphic wattmeter was connected into the power line to the mixer, the wattmeter being placed in the job office.

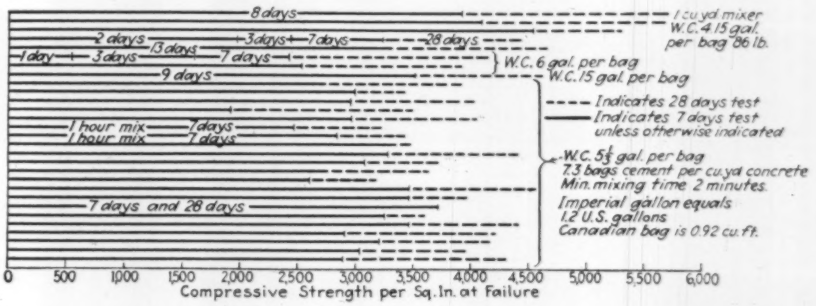
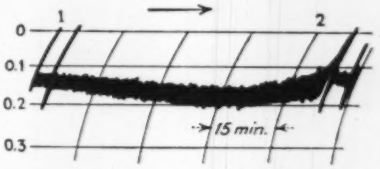


Fig. 4—Test record of concrete produced with various water-cement ratios and mixing periods.

While the wattmeter was installed for the specific purpose of insuring that the required mixing time was given to each batch of concrete, it served other purposes as well. For instance, it indicated the progress of the pour, recording any delays that took place, showing whether they were on the feeding side of the mixer or on the take-away and indicated any change in the conditions of the mix as to whether there was a change in the water or whether a barrow of sand or a bag of cement had been left out. Such changes immediately affected the power required, producing an irregularity in the chart in proportion to the power change. The chart was also a positive and correct record of the number of batches of concrete or grout mixed, and it registered any delay in starting operations or loss of continuity in the mixing operations.

Fig. 1 shows a section of the record made when a lean grout mixture was being put through the mixer and the water was not controlled as to amount, the mix being hosed into the voids in rubble masonry fill. The steps in the discharge line are due to the batch being taken from the mixer in buggies, and the varying height of the different batch lines are due to the variation in the amount of water in the different batches. The horizontal space at 1 indicates the mixer running empty due to slow charging, and the horizontal heavy line at *2* is the mixing time after the water has been distributed through the mix, while 3 indicates an interval between buggies on the discharge.

Fig. 3—Wattmeter record when mixer was run charged for an hour between discharging batches.



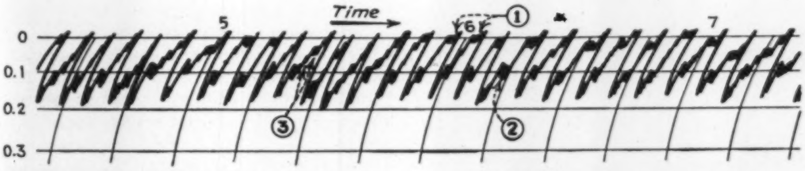


Fig. 1 (above)—Wattmeter record when mixing grout with varying percentage of water for filling rubble masonry.

Fig. 2 (below)—Wattmeter record when mixing concrete in regular run for wall construction.

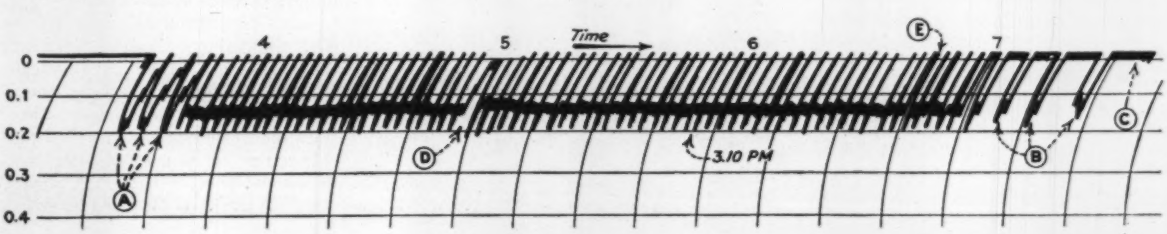


Fig. *2* is from a regular concrete run

with the mixer discharging into the tower bucket. Points *A* indicate three batches of grout mixed preceding the mixing of the concrete; *B* indicates that the mixer was being held to complete the pour; *C* shows the mixer was run empty for about 10 min. after the last batch was out, for washing-out purposes; *D* shows that the batch was not completely emptied out of the mixer—consequently the peak of the next load is a little higher than usual—and that for some reason there was a slight delay in operations; while *E* shows that the charging of the mixer was not done as soon as it should have been done.

Fig. 3 is a record of the power requirements during an interval of over an hour when there was a breakdown in the hoist and the charged mixer was kept in operation. It may be noted that the power requirements went up for about 40 min. and then gradually downward. Test cylinders taken from this mix showed practically the same strength as other cylinders taken from the ragular mix, as shown in Fig. 4.

◆

Multiple Periods in Vibration of San Francisco Buildings

Observations on fifteen high structures show short-period movements in addition to fundamentals—Marked vertical component observed in several

OBSERVATIONS by Perry Byerly, James Hester and Kenneth Marshall on the vibratory movements of fifteen high buildings in San Francisco, reported in the *Bulletin* of the Seismological Society of America, December, 1931, showed the unexpected fact that in some of the buildings the fundamental vibration is accompanied by a shorter period movement and that in certain cases a distinct vertical component of vibration exists. In addition, a much more rapid vibration, or tremor, believed to be due to traffic disturbances, was evident in several of the structures. The observations were made with the vibration recorder of Prof. E. E. Hall, of the University of California, described in *Engineering News,* Aug. 1, 1912, p. 198, and constructed by him primarily to study traffic-disturbance effects. The instrument is a three-component seismograph, in which the two horizontal movements are measured by conical pendulums, each of 25-lb. mass, while the vertical movement is measured by a 25-lb. weight suspended from three springs, all masses being damped by vanes in oil.

No data on amplitude of motion are given except for the statement that in no case was the amplitude greater than 0.2 mm.

The long period of the several buildings in no case exceeded 2 sec. Where a secondary period or harmonic was present in combination with the fundamental (in several cases there was more than one such secondary period), this period ranged from one-half to one-tenth the fundamental period. In one case two directly adjoining buildings of approximately the same height showed identical periods in the direction parallel to both, indicating that they vibrated as a unit. The vertical vibrations, observed in more than half the buildings, had periods ranging between 0.04 and 0.58 sec.

VIBRATION PERIODS OF SAN FRANCISCO BUILDINGS

Building	Horizontal Dimensions, Feet	Height Above Ground, Feet	Height Above Ground, Stories	Periods of Vibration, Sec. Horizontal N-S	Periods of Vibration, Sec. Horizontal E-W	Periods of Vibration, Sec. Vertical
450 Sutter St.	138x160	340	26	1.2	1.4	......
Shell Bldg., Bush & Battery Sts.	117x137	389	29	1.80	1.85	......
Russ Bldg., Montgomery, Pine & Bush Sts.	275x166	435	33	1.71 0.78 *0.08	1.89 0.85 0.17 *0.06	0.23 0.05 ....
Hunter-Dulin Bldg., Sutter & Montgomery Sts.	100x160	309	24	1.48 0.49 0.05	1.33 0.15 *0.09	....
Mark Hopkins Hotel	193x171	257½	19	1.27 0.14	0.95	0.21 0.05
William Taylor Hotel, McAllister & Leavenworth Sts.	137½x137½	325	28	1.34	1.32 0.57	0.04 ......
Alexander Bldg., Bush & Montgomery Sts.	69x 60	204½	15	1.23 *0.39	1.32 0.41	....
Sir Francis Drake Hotel, Powell & Sutter Sts.	116x138	282	23	1.49	1.82 1.29	0.51 ......
Bank of America, Market & New Montgomery Sts.	82x 48	181	15	1.64 0.90 0.50	1.41 0.90 0.43	0.52 *0.07 ......
Pacific Gas & Electric Co. Bldg., Market & Beale Sts.	137½x137½	262	17	*0.07 1.50 0.90	.... †1.28 0.55	....
Matson Bldg.	133x133	320	17	1.44 1.21	†1.26	0.53
Insurance Center Bldg., Pine & Sansome Sts.	206x 84	206	16	1.41 0.20	1.07 0.48	....
De Young Bldg., Kearny & Geary Sts.	....	....	16	1.53 0.59 0.17	1.36 0.90 0.15	0.55 *0.08 ......
Western States Life Bldg.	90x 63	207	15	1.03 0.18	1.33 0.16	....
City Hall	....	....	..	....	0.65	......

* Vibrations believed due to traffic.
† Vibrations of P.G.&E. and Matson buildings are considered to be a coincident vibration.

◆

Machinery Vibrations by Seismograph

A small seismograph has been developed in the general engineering laboratory of the General Electric Co. for the measurement, in thousandths of an inch, of vibrations in steam turbines or other machinery. Within its case, which is bolted to the machine under investigation, there is a block of lead held in position by two springs on the top and four springs on each side. The outside shell of the detector vibrates at the same period as does the machine to which it is attached; but the lead weight, because of its mass and low natural frequency, remains fixed in space. In the weight are embedded two coils, on opposite sides. In front of each coil is an adjustable piece of magnetic steel, fastened to the outer shell. The coils in the weight are energized by 500-cycle alternating current, and the air gaps between the coils and pieces of magnetic steel are adjusted so that the two coils are electrically balanced—the amount of current through the coils depending on the distance of the steel pieces from them—giving a zero reading on the indicator when there is no vibration. Vibrations, however, cause a swaying of the outer shell of the instrument, varying the distances between the coils and the magnetic pieces and consequently the current in the coils—differences that are translated into thousandths of an inch in vibration readings.

The device is an application of the electric micrometer, an instrument that has been found serviceable for numerous types of measurements. One form is a strain gage, which, with a 2-in. expansion between the mounting holes, can be bolted or clamped to the structural member under investigation. The coils are mounted in cylindrical holders that slide inside the block. The block and armature are fastened to one side, and the coils to the other side. A 2,000-cycle excitation current is used with the gage, thereby making it possible to record with an oscillograph transient strains that occur in a fraction of a second. A steady strain can be observed on an indicating instrument, using a 60-cycle excitation for the coils.

Plant-Mix Oiled Roads in New Mexico

Methods and costs of constructing 110.6 miles of plant-mix roads in the emergency loan roadbuilding program of 1931

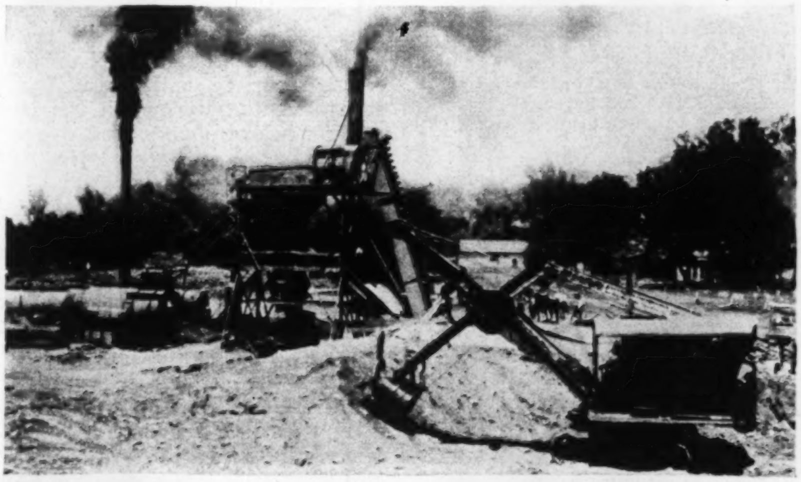
By William C. Davidson
Formerly State Highway Engineer of New Mexico, Santa Fe, N. M.

DURING 1931 the New Mexico highway department completed 110.6 miles of plant-mix oiled roads. These roads were built upon the federal highway system and received government aid. From cost data recently prepared by the state highway department, it is revealed that the average cost of these roads was $6,700 per mile. The cost per square yard was 57c. Engineering amounted to 3.4 per cent of the total cost.

The oiled mat was constructed 20 ft. wide and 3 in. thick. When compacted, this loose-measure thickness resulted in a final depth of 2½ in. Compaction was obtained by blading, rolling and particularly from traffic. The edges of the mat were thickened to 5 in. to protect the areas where the surfacing receives its most severe test. The department has adopted edge thickening as standard for all oiled mats. It has been found that it greatly reduces upkeep cost.

Construction materials

The oil used was an asphaltic-base product, containing 70 to 80 per cent of asphalt. In plant-mix construction an oil of higher asphaltic content than would ordinarily be employed in road-mix operations may be used. Throughout the 1931 construction program a 65-70 oil was used for road-mix work, whereas a 70-80 oil was specified for plant-mix. It is also generally considered that higher viscosities are permissible in plant-mix construction.



Typical central mixing plant for plant-mix oiled-road construction in New Mexico, including gravel pit and crushing unit.

There were used in the mat itself an average of 2 gal. of oil per square yard. This did not include the seal-coating. The amount of oil required for the construction of the mat varied according to the physical characteristics of the aggregate. As an illustration, a certain project required 1.57 gal. of oil per square yard, while another project required 2.7 gal.

In the main, two aggregate characteristics govern: the absorptive quality of the stone composing the aggregate and the quantity of fine material. A stone that is porous will absorb a considerable quantity of oil, thereby requiring the addition of more oil in order to obtain a mix of the desired consistency. Likewise an aggregate containing a high percentage of fine material will require a greater amount of oil to insure the coating of all particles than will an aggregate composed of a lesser quantity of fines. The approximate quantity of oil required by a given aggregate was predetermined in the laboratory. Daily tests were made in the field to verify the laboratory's recommendation.

In most cases the aggregates were obtained locally, within truck-hauling distance of the job. Two projects only required railroad shipment.

The aggregates were sand and gravel obtained from arroyos, creeks or bank deposits. It was required that all aggregates should be crushed to insure the best possible mechanical bond. Screening to reject oversize was not permitted. The size of the aggregate varied from the 1-in. maximum to 200 mesh. A maximum of 15 per cent of 200-mesh material was permitted; it is believed that from 10 to 12 per cent of the 200-mesh size produce the best results.

Particular comment concerning the 200-mesh material seems pertinent. Observation has shown conclusively that a relatively high percentage of the filler, or 200-mesh size, produces the denser mat. Care in the selection of the quantity and quality of these fines is, however, an important factor. Colloidal clay and caliche should be avoided; the quantity of these elements must be small, if success is to be assured. Instability of mat and a tendency to emulsification is the penalty paid because of the use of excessive amounts of clay or caliche.

Dumping plant-mixed material on road. Typical operation on plant-mix construction in New Mexico. One mile of surfacing was placed every three days.

Spreading plant-mixed material with motor grader. Typical procedure on plant-mix construction is shown.

Construction methods

The mileage in question was built by contract. Construction began during the latter part of March and was completed about Sept. 1. In New Mexico the rainy season generally occurs during the summer, particularly the months of July and August. The construction season, therefore, corresponded with the rainy season. It is well known that rainy weather is decidedly unfavorable to oiled-road construction, whether it be plant-mix or road-mix. If oil-mixed materials are laid down in a wet condition, wrinkling and corrugations are certain to follow, and ultimately the surfacing will have to be torn up and dried out.

It so happened, however, that this particular season was considerably below normal in rainfall, at least during those months in which it would usually be greatest. The contracts were, therefore, carried forward with unusual dis-

After spreading the mixed material the surface is bladed for two or three days to keep it in a smooth condition while being compacted by traffic.

A road roller is used in compacting the edges of the oiled mat, which are thickened to reduce raveling.

patch and with one exception, were completed on or before scheduled time. An engineering cost of 3.4 per cent would, in itself, indicate a fair rate of construction progress. The usual cost of this item in New Mexico is about 4 per cent.

An anlysis of the working progress on the several projects indicates that an average of three working days was required for the construction of 1 mile of road. In plant-mix construction, as in road-mix construction, rainfall is the controlling factor. Plants are equipped with heating and drying devices, so that there is little delay due to wet pit materials. The principal handicap is wet subgrades. When this condition exists, operations must cease awaiting the action of wind and sunshine.

It is important that the mixed material be spread and finished as soon as possible after dumping. This is necessary to avoid the possibility of its becoming saturated by rainfall while it is still in the windrow. An effort is made to lay down and finish each day's run before suspending operations for the day. This reduces to a minimum the rainfall hazard. The contractor is responsible for the drying out of wet materials on the road. It therefore behooves him to take every precaution in the matter of completing and finishing each day's work.

In many cases the oiled mats were placed upon old gravel bases, some of which were built several years ago and required widening and thickening in order to provide satisfactory foundations. A width of base of 22 ft. was required. The minimum thickness of base was 3½ in. As previously stated, the mat was built 20 ft. wide. Thus a margin of 1 ft. on each side of the mat was provided to minimize edge failures. The 3½-in. base, plus the 2½-in. mat, provided a total thickness of 6 in., this being the minimum thickness allowable under existing standards.

Many of the original gravel roads were built 16 to 18 ft. wide, with thicknesses varying from 6 to 8 in. After several years of service these thicknesses had become greatly reduced, and in some cases they were below the 3½-in. requirement. Base material had to be supplied to increase both width and thickness. An expenditure of $300 per mile was involved in reconditioning the existing bases.

Certain projects of more recent design and construction had ample bases. Such projects were built as stage construction jobs and were programed for oiling as the final stage. Since the beginning of the oiling program four years ago practically all new projects have been built to a standard that would permit of oiling without involving the reconstruction of the bases.

Under the contracts covering this oiling program the basis of payment was by the ton of mixed material in place. The contractor furnished all materials except the oil, which was supplied by the state. The work was performed under the emergency program, and consequently the time for completion was less than it would have been otherwise. This fact probably resulted in higher costs than would have prevailed had the contractor been permitted to pursue a normal rate of progress on the work.

It was found that there was required 1,760 tons of mixed material to the mile of 20-ft. roadway with 3-in. depth; that 300 lb. of mixed material was required for each square yard of surface; that a ton of mixed aggregate and oil was composed of 1,900 lb. of aggregate and 100 lb. of oil; that of the 1,900 lb. of aggregate, 1,200 lb. was fine aggregate (material below the 10 mesh) and 700 lb. was coarse aggregate (material above the 10 mesh); and that 2 gal. of road oil was required for each square yard of road surface.

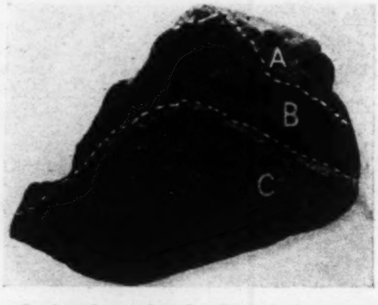
It was found further that the average cost of the 110.6 miles of improvement, exclusive of preliminary expenditures on the bases, was $6,700 per mile; that the cost per square yard was 57c.; that the preliminary expense in preparation of bases was $300 per mile; that the engineering expense was 3.4 per cent of the total cost; that the oil delivered to the siding nearest the job represented 21 per cent of the total cost; and finally that the total cost of the road surface, including all costs, was $7,000 per mile.

The illustrations in this article have been furnished through courtesy of the state highway department of New Mexico.

◆

Twelve-Year-Old Gunite Found To Be in Good Condition

IN DEMOLISHING the 28th St. bridge over the Pennsylvania Railroad tracks in Pittsburgh last fall, an opportunity was offered to inspect a gunite covering placed on the under side of the structure in 1919. The bridge had been built in 1880, and in 1908 the lower portions of the beams and girders were incased in concrete. The gunite work in 1919 was carried out to protect the under side of the concrete where it had deteriorated from locomotive blast and gases. In demolishing the bridge, slabs of concrete and gunite were cut out and broken up with pneumatic hammers. Efforts made to split the gunite away from the concrete were unsuccessful. The accompanying illustration shows a typical piece of one of these slabs. The portion marked *A* is a part of the old concrete, while *B* is the main body of the gunite. *C* is the ½-in.-thick "flash coat" of gunite, which has been directly exposed to the locomotive blast for a period of twelve years. The impermeability of the flash coat is shown by the fact that No. 14 gage black tie wire, which had been used for holding the shooting strips in place and which later was covered with the flash coat, was found still to be black in color and showed no loss of sectional area. There was no evidence that the deterioration of the concrete had proceeded after the application of the protective coat. A sample cut from the gunite where it was $1\frac{5}{16}$ in. thick, tested in the bureau of tests of Allegheny County, showed a compressive strength per square inch of 16,700 lb., according to John V. Schaefer, president, Cement Gun Construction Co., Chicago.



Gunite shown by the *B* and *C* areas, applied to a concrete covering of steel beams and girders in 1919, shows good bond and high compressive strength when removed twelve years later. The *C* area of gunite is the flash coat, which was exposed directly to the blast of locomotive gases.

Steel-Plate Floor of New Type Installed in Several Buildings

Latest and largest installation of "keystone-beam" units made in Pittsburgh, where an extra floor was added to a light manufacturing building to convert it into a railroad warehouse

THE FIRST major installation of a new steel-plate floor unit known as the "keystone beam" has recently been completed by the Baltimore & Ohio Railroad Co. in Pittsburgh, Pa., where a mezzanine has been added to a light manufacturing building to convert it into a warehouse for the Kroger Grocery Co. About 1,500 floor units were required, of which 1,350 were of the same size, 2 ft. wide and 7 ft. 7 in. long. The new floor, located between the existing first and second floors, was designed to carry 250 lb. per sq.ft. live load and covers an area of 22,625 sq.ft. The floor was laid and welded to new framework in 3½ days.

The new flooring, of cellular construction, gets its name from the fact that the cells are keystone-shaped. It was developed by the H. H. Robertson Co., of Pittsburgh. The warehouse floor follows five previous installations, as well as research programs carried on during the past two years at the U. S. Bureau of Standards in Washington and the Mellon Institute of Industrial Research at Pittsburgh. Each of the five previous jobs involved a relatively small area. They were as follows: scale house for Pennsylvania Railroad, Baltimore, Md.; bleachers at Arsenal High School gymnasium, Pittsburgh; bleachers at Westinghouse High School gymnasium, Pittsburgh; office building for New York Central Railroad at pier K, Weehawken, N. J.; and filling station for the Standard Oil Co. of Ohio, at Cincinnati.

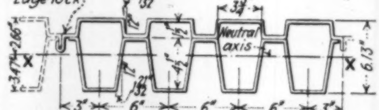


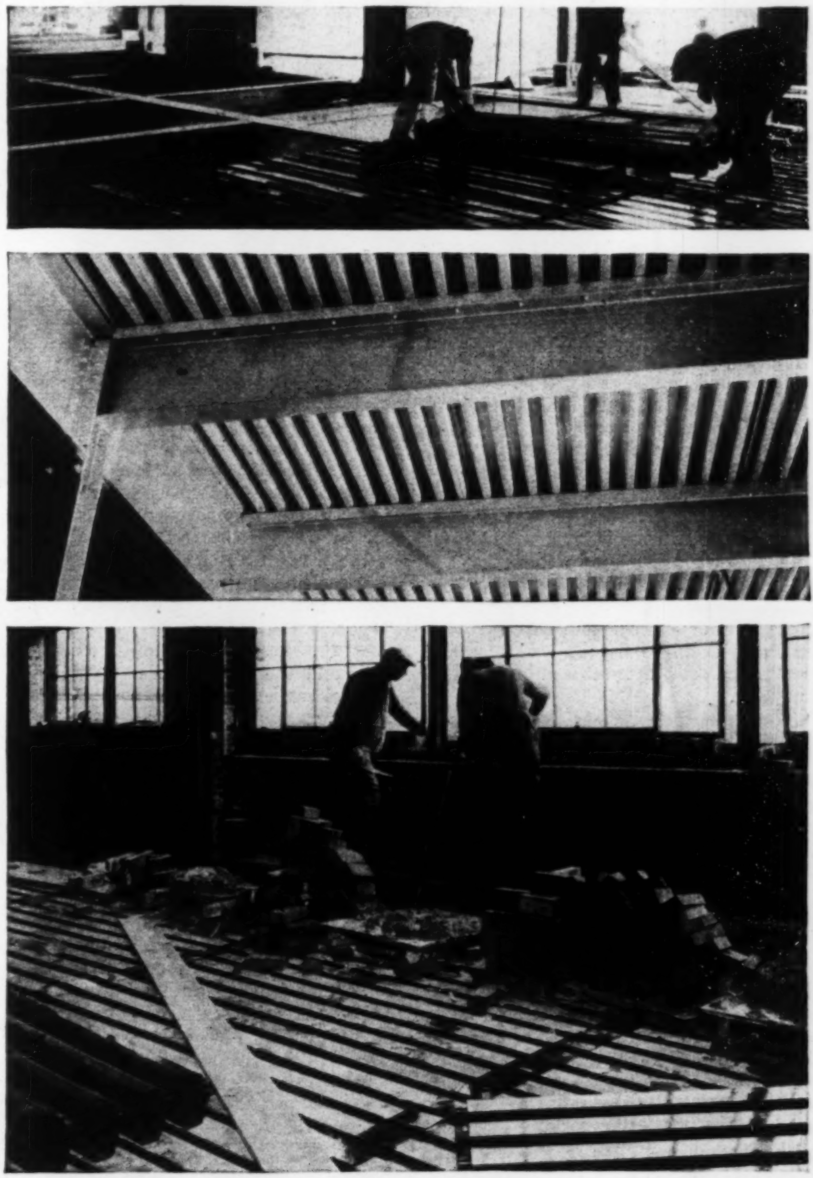
Fig. 1—Cross-section of keystone-beam unit used in Pittsburgh warehouse. Both top and bottom elements are 16-gage sheets.

Each floor unit is made of two preformed steel sheets. The cross-section (Fig. 1) shows four keystone-shaped cells formed by a V-shaped bottom element and a U-shaped top element, welded together above the neutral axis. For the heaviest units a two-cell section 12 in. wide is also available. Units are made in span lengths from 6 to 30 ft. Except for special cases, the maximum weight of a unit is about 400 lb. Units weighing less than 250 lb. have the widest range of usefulness.

The floor is designed to meet heavy-duty requirements and is available in several forms, all of which are variations of the type illustrated. Thus, two bottom elements may be combined to provide a deep stiff floor, or two top elements may be used together when a shallow floor for lighter loading is specified. It is also possible to use either the top or bottom element in combination with a flat plate. The load and span range of the units shown in Fig. 1 may be increased by using narrow flange plates at the top and bottom of each cell.

The floor was developed by the Robertson Co. as a result of experience with its protected V-beam roofing on the dirigible hangar at Akron, Ohio, (*ENR*, July 24, 1930, p. 135). Similar sheets were first tested from a load-carrying standpoint about seven or eight years ago, and during the past

Fig. 2—Installing keystone-beam steel-plate floor units in Pittsburgh warehouse. In top view a unit 24 in. wide and 7 ft. 7 in. long, weighing 150 lb., is being set. Center view shows bottom of completed floor. The lower view indicates how bricklayers worked from the completed floor, eliminating outside scaffolding. Note in this view the short splice plates used at transverse joints.



three or four years further study has been made of a combination of the V-shaped corrugated sheets and a top and bottom element. Within the past year and a half more intensive studies have been made on those sections that previous tests had indicated might be successful.

Some of the advantages claimed for this light-weight flooring are: (1) lighter floor beams are required; (2) wider spacing of floor beams is possible; (3) column sections may be lighter; (4) foundations and grillages may be made less costly; (5) the floor may be placed by ironworkers immediately following the structural-steel erection; (6) floor material can be placed in its final position immediately upon arrivel at the building site, thus conserving storage space and furnishing immediately a working platform for other trades; (7) rapid construction is possible; (8) temporary floor planking to meet safety regulations is not required; (9) the floor is adaptable to welding, thus minimizing construction noise; (10) the floor is incombustible; (11) from a load-carrying standpoint the floor meets all code requirements; (12) it is easily adaptable to related construction such as wiring, steam and sanitary piping, suspended ceilings, etc.; the cells provide extreme flexibility for wiring layouts when used as electric conduits; (13) any type of wearing surface may be applied.

The floor units used to date have been made of pressed-steel sheets, but it is contemplated that a special rolling mill now nearing completion will be used for future manufacturing. After the top and bottom elements are formed in the shop, they are welded together by the resistance process, two lines of spot welds 1½ in. apart being placed in each groove. After welding, each section is either dipped in a hot asphalt material to protect against corrosion and serve as a binder and cushioning layer between the steel flooring and the concrete slab, or it receives a baked enamel finish as required by the underwriters, when the cells are utilized as electric conduits.

Pittsburgh warehouse job

The warehouse building in Pittsburgh, originally used for light manufacturing, had brick side walls and 3-in. wood floors supported on wood beams, in turn carried by plate girders spanning from the outside wall columns to a column at the center of the building. The first-story ceiling height of 25 ft. was sufficient to permit the introduction of a mezzanine floor to be carried on steel framing, refabricated at the building site from existing plate girders taken from old crane runways in the building. Additional columns also were placed between the existing center columns and the outside walls, bringing the cross-spans down to 22 ft. 9 in. The new framing then consisted of girders spanning transversely over the columns, with floor beams at right angles to the girders and 7 ft. 7 in. apart. The floor units were placed parallel to the girders.

About 1,500 floor units were used, of which 1,350 were the same size, 24 in. wide and 7 ft. 7 in. long, with both top and bottom elements made of 16-gage sheets. Typical properties of the section (Fig. 1) based on a 12-in. or two-cell width, are: section modulus 3.60, moment of inertia 12.5, maximum moment 57,600, maximum load capacity on a 7½-ft. span about 675 lb., and corresponding deflection about 0.09 in. Some 150 units were specially fabricated to fit around the center and side-wall columns, elevators, doors, etc. These were all numbered and when delivered to the job were laid in place without any further cutting.

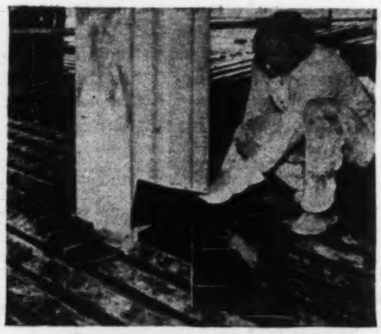


Fig. 3—Special fittings were used around columns to provide a watertight deck for the concrete floor fill.

The accompanying illustrations indicate how the units were installed. Two men, one at either end of a 150-lb. unit, easily handled it into place where the hooked edge-lock held it firmly. After the units were in place, they were welded to the floor beams at every other cell, an opening having been provided for the welding torch by manufacturing the top element of each unit about 2 in. shorter than the bottom element. Tack welds about ¾ in. long were then made along the longitudinal joints between units, and the floor was completed by tack-welding splice plates, formed to fit the corrugations, at all transverse joints.

Unusually rapid progress was made in installing the flooring. Work was begun on a Wednesday at 10 a.m., and the entire area of 22,625 sq.ft. was laid and welded by noon on Saturday, 3½ days later. This time could have been shortened if it had been economical to utilize enough riveting gangs on the frame to keep ahead of the floor-erection crew, which consisted of a foreman and six men. There were four riveting gangs that worked until midnight, and the floor-erection crew caught up with them shortly after 3 o'clock each afternoon. The remainder of the day was spent in carrying sheets from the front of the building to the rear, where the floor was being built.

In laying the steel, four of the men constituted a ground crew and handed the sheets to two men on the mezzanine floor, who either stacked them for another crew to lay or laid them in place immediately. Since this was a rush job, two welders worked on Thursday and six on Friday and Saturday.

At each column and along the wall a special flashing was furnished, so as to provide a watertight deck for pouring the concrete wearing surface. The floor finish specified was 2½ in. of concrete above the high part of the top element of the floor. The slab was reinforced with 21-lb. road mesh to prevent temperature cracks. No openings for steam risers or pipes were made in the floor before it was laid, but after the floor was welded in place the holes were laid out and burned through in the exact location desired.

The work was designed by L. C. Kimball, engineer of buildings for the Baltimore & Ohio Railroad Co. The Rust Engineering Co., Chicago, was the general contractor.

Off-Street Parking Increases in Chicago Loop District

An increase of 15 per cent in off-street automobile storage facilities in the Chicago downtown business district, for the year ending Dec. 31, 1931, is disclosed in a recent survey made by the Chicago bureau of streets. Leslie Sorenson, engineer for the traffic engineering division, gave the following figures to the street traffic committee of the Chicago Association of Commerce. A total of 88 parking lots and 47 garage buildings was found, being a net gain of 30 establishments. The present physical capacity is 23,217 cars, of which 11,025 are in parking lots and 12,192 in garages, an increase of 3,000 cars over 1930. In 1926 the off-street facility was 8,732 cars, while in 1927 it was 13,261. The total number of vehicles using this space was 17,297 in 1931, as compared with 16,362 in 1930, an indicated increase in usage of 5.7 per cent. This increase is supported by the 5.84 per cent increase in passenger vehicles entering the Loop district, as disclosed by the 1931 cordon traffic count. The available space has increased faster than the absorption, as there is now available space for 5,920 additional cars, compared to 3,819 cars in 1930.

In the face of the above increased facilities and vehicles entering the Loop, the widely advertised Loop no-parking ordinance, five years old, is under fire. Merchants ask repeal. One department-store owner claims the Loop is losing $80,000,000 per year due to the no-parking rule. But accidents decreased after the law went into effect early in 1928, the figures for 1927, 1928 and 1929, being 692, 473 and 293, respectively, with thirteen, nine, and five deaths.

Improved Clay Sampler Used for Bay Bridge Borings

Tool works successfully at great depths in San Francisco Bay—Sample removed in brass sleeve and sent hermetically sealed to laboratory

AN IMPROVED sampling device for removing specimens of clay from foundation drill holes has been developed in connection with the exploration program for the San Francisco-Oakland bridge. The sampler was developed to overcome difficulties in the control of the sampling operation and to reduce the possibility of change and losses in the sample up to the time it is actually tested in the laboratory. Two styles of tool permit taking 5- or 2-in.-diameter samples 1 ft. long. The device has been used to a depth of 273 ft. below water level.

The removal of clay samples from foundation strata for laboratory investigation is of particular importance on the eastern section of the proposed structure, between Yerba Buena Island and the approach fill on the Oakland side. Drilling revealed clay underlying the bottom silt to depths up to 300 ft. To determine the possibility of founding piers on this material and the loads that it could sustain, it was essential to secure samples of the clay in its undisturbed condition at frequent depths as drilling progressed.

Prior samplers

The sampling device previously used in similar material comprised a steel pipe whose lower edge was formed to make a circular chisel-like cutting edge, the bevel being on the outside. The outside diameter of the sampler was somewhat smaller than the inside diameter of the casing pipe in use, and the length was about twice that of the desired sample. At the upper end holes in the side wall permitted the free outflow of water. Connection was made between the upper end of the sampler and the lower end of a drill rod of sufficient length to reach the surface.

In operation all material within the casing pipe was removed down to the bottom of the casing, the sampler tube was lowered to the bottom, and by means of a jack or heavy weight placed on the upper end of the drill rod the sampler was forced into the clay, the small holes in the top of the sampler permitting the water caught above the sample to escape.

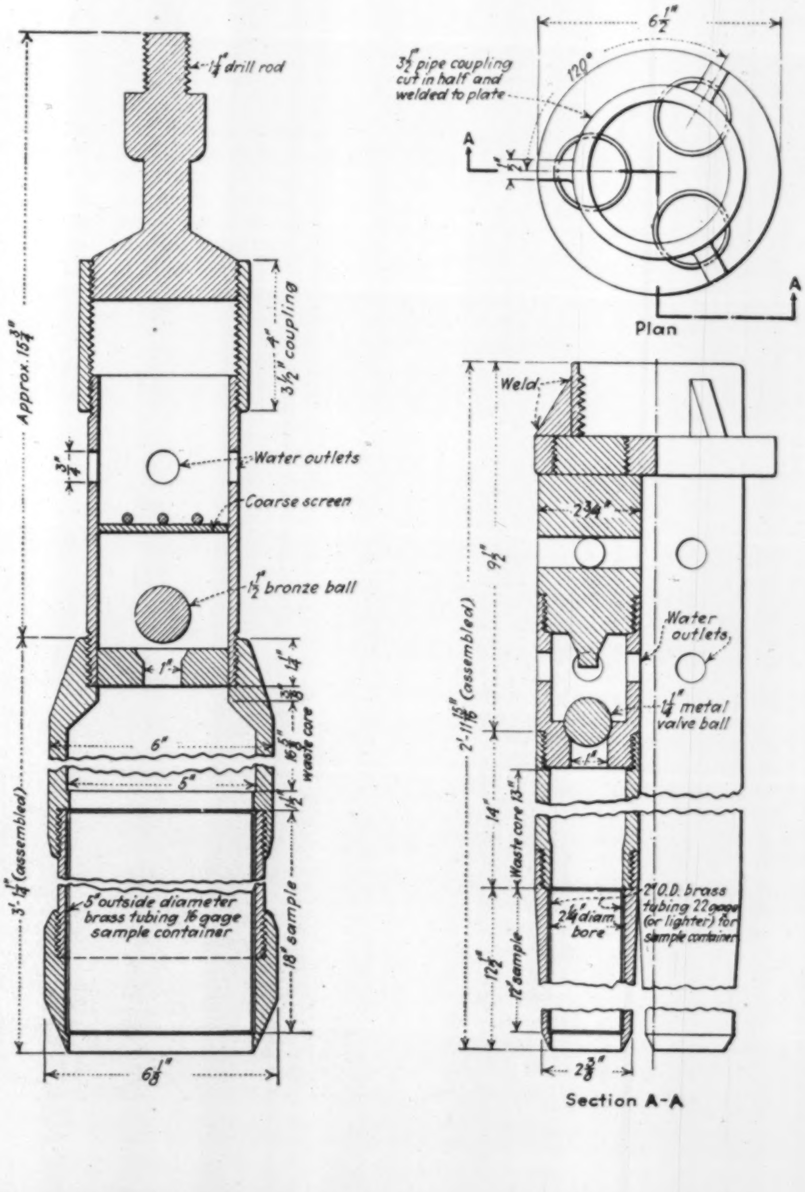
When the sampler filled with clay was brought to the surface it was generally necessary to connect one end of the sample tube with a supply of water under 30 to 50 lb. pressure, in order to force the sample out of the sampler, and finally it was necessary to cut the sample into pieces that could be placed in airtight containers, for which glass preserving jars with metal caps were ordinarily used. The operations of removing the sample from the sampler, repacking the sample in a jar, in which the sample was exposed to air and was unrestrained as to shape change, were all objectionable features of the operation, so that there was a serious question whether the sample, on reaching the laboratory for tests, was a true sample unchanged in all respects from the natural material in the clay stratum.

The new device is a radical improvement on the old method, as it provides a cylindrical brass lining sleeve to receive the sample entering the sampling tube. This sleeve becomes the container in which the sample is sealed, protecting it from contact with air and from the free movement of the sample in the jar container.

Sampler assembly

The important element of the new tool is the brass sleeve fitted inside the sampler pipe. This sleeve receives the sample as the device is pushed into the bottom of the drill hole, and upon withdrawal it is removed and immediately capped with brass caps that are sealed on with paraffin. Thus, the sample

Subsoil sampler for obtaining clay cores in deep drill holes. Single-sample tool at left produces 5x18-in. sample. Triple sampler, at right, produces short 2-in. samples for permanent record. Successful cores have been secured 273 ft. below water.



Plan

Section A-A

when sent to the laboratory is virtually undisturbed and has minimum opportunity for physical, chemical and moisture variation.

The general assembly is shown in the accompanying drawing. Coupled on the end of the drill rod is a socket, which ends in a standard 3½-in. pipe coupling onto which is screwed the sampler unit. The uppermost part of the sampler consists of an 8-in. length of 3½-in. pipe containing the water outlet holes, a coarse screen and a ball valve to provide outlet for the water and a vacuum during lifting of the sampler.

The lower section consists of: (1) a 20-in. length of pipe to receive the upper end of the core (which is wasted); and (2) the actual sample chamber, 18 in. long, which is lined with a sleeve of 16-gage brass tubing. The sleeve, 5 in. in diameter, fits against shoulders at top and bottom. The entire unit is assembled with threaded connections.

Operation

In operation the sampler is assembled and lowered into the bottom of the hole, which has been thoroughly cleaned. The upper end of the drill rod is fastened in an adjustable jack yoke. Power to force the sampler into clay is produced by a hydraulic jack operating in the yoke, which permits a slow, even and readily controlled operation.

When the depth of jacking indicates that the sampler has been forced into the clay its entire length, sinking is stopped and the tool is drawn. Upon arrival at the top the brass sleeve is removed, the surplus material at top and bottom is cut off even with the ends of the cylinder by means of a wire saw, and the sample is immediately capped and then sealed with paraffin and adhesive tape. It should be noted that the actual sample occupies only the lower half of the sampler shell and that the cutting edge of the shell projects beyond its lower end. This arrangement provides that any disturbed material at the bottom of the hole is wasted and that 1 in. or more of material is cut from the bottom of the sample.

A modification of the design provides for taking three 2-in. cores simultaneously. The three samplers are fixed in a common head, which is in turn connected with the drill rod; the same jacking process as above described provides the three small cores. It is the general practice to keep these smaller samples for permanent records and to use the larger 5-in. cores for the present laboratory tests. To produce a greater number of individual specimens that might be needed at a future date, the brass sleeve for the smaller samples can be assembled as six individual 2-in. sections. Upon removal of such a sample a wire saw cuts through the clay between the sections of brass tubing and produces six 2-in. samples.

A further modification of the sampler design provides for taking a single 2-in. diameter sample. This style is used where the clay stratum is so hard that it is impossible to use the 5-in. or the triple sampler.

The sampler has been used up to the present in eleven exploration holes, removing specimens at 10-ft. intervals. Nine of the holes extended 150 ft. below water level, and two were put down to a depth of 273 ft. No trouble has developed in the operation of the device.

Handling samples

Capped and sealed samples are sent immediately to the testing laboratory of the University of California. They are stored in a constant-temperature room at 70 deg. until removed for testing. On removal, the caps are taken off and the cylinder is run through a milling machine to cut the sleeve in half. This permits removal of the core without distortion and is far superior to any method that involves forcing the sample out of the shell.

Personnel

The sampler was designed by J. L. Beatty, assistant engineer, under C. E. Andrew, bridge engineer, and G. B. Woodruff, engineer of design, of the Bay Bridge project. The board of consulting engineers, comprising Ralph Modjeski, chairman, Daniel E. Moran, Leon S. Moisseiff, Charles Derleth, Jr., and H. J. Brunnier, cooperated closely in the sampler design and the subsoil investigations.

The project is under the direction of the department of public works of California, Col. Walter E. Garrison, director, and Charles H. Purcell, chief engineer.

Wall of Reinforced Brickwork Incloses Steel Water Tank

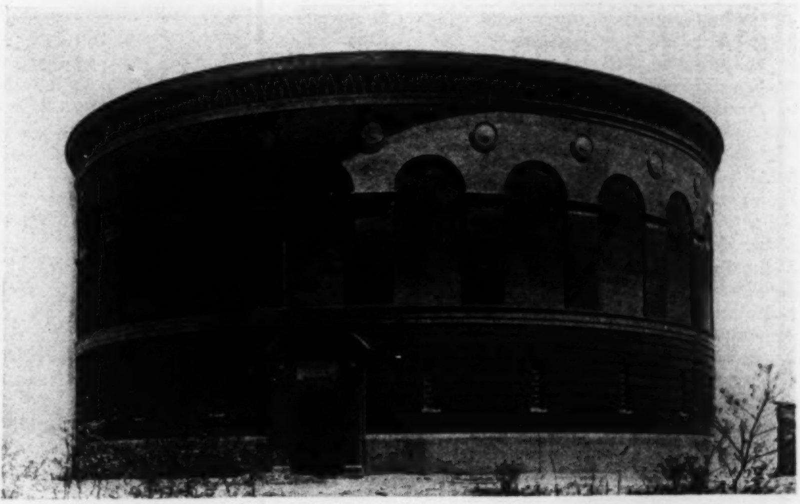
FOR THE first time in this country, reinforced brickwork has been used in connection with a masonry inclosure for a steel water tank, in Baltimore, Md. In developing the architecture for the inclosure great attention was paid to the color scheme, nineteen shades of brick being used to obtain a gradual shading of color from dark brown at the bottom to light tan at the top.

The tank proper has a capacity of 4 m.g. and serves the Curtis Bay district of the city. Its primary purpose is to raise the hydraulic gradient during periods of heavy draft. It also provides a twelve-hour reserve supply of water in case of failure and subsequent repair of the 30-in. main leading to the section. The main is laid in a waterfront street that crosses over several mud flats and shows a tendency to settle along this portion.

A thick concrete slab on the ground serves as a foundation mat. The steel tank is 110 ft. in diameter and 50 ft. high from the base to the top of the plate section. The top is in the form of a spherical dome and rises 20 ft. above the sides, being visible above the masonry inclosure.

A circular brick wall, 119 ft. in outside diameter, completely incloses the tank, with a clear space of 2½ ft. left between the steel shell and the wall. The wall varies in thickness from 17 to 13 in. and, because of its thinness, is re-

Fig. 1—Reversed order of color grading in the depressed panels serves to accentuate their depth.



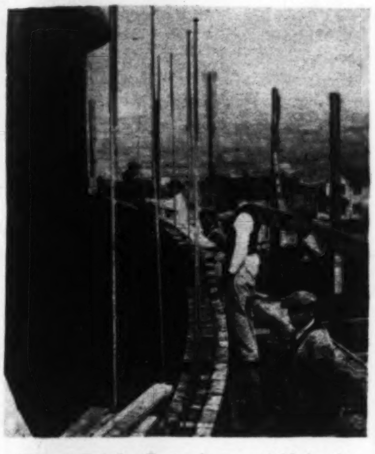


Fig. 2—Reinforcing rods were laid in the horizontal joints to protect the thin wall section against contraction stresses. The vertical rods are to anchor the terra cotta cornice.

inforced with steel rods to protect it against contraction stresses. Two ¼-in. rods were used in every eighth course of the first 20 ft., one ¼-in. rod in every fourth course for the height of the depressed panels and two ¼-in. rods for every fourth course for the remainder of the height. The reinforcement was considered especially necessary at the bottom of the wall where the brickwork is laid on a 6-ft.-high concrete base course.

The general color scheme is to shade imperceptibly from dark at the bottom to light at the top. The concrete base course was made with ¼-in. gravel specially selected to give a dark brown shade when exposed by the scrub finish. The first few courses of brick are also dark brown and then gradually shade into a light tan at the top of the wall. A cornice of light tan terra cotta surmounts the wall, tied into it with vertical steel rods. Intermediate trim, consisting of belt courses and window grills, are also of terra cotta, of the proper shade to harmonize with the color of the brick at that point.

The surface of the wall is relieved by 24 depressed panels topped with circular arches. Within the panels the color shading is reversed, dark at the crown of the arch to light at the bottom of the panel. This reversal of shading has the effect of giving a great contrast between the panel and the surrounding wall surface and makes the panel appear deeper than it really is.

The steel roof over the tank, visible above the masonry inclosure, has been painted a copper green.

The cost of the steel tank alone was $55,250, and that of the inclosure $45,000.

◆

Progress on Mittelland Canal

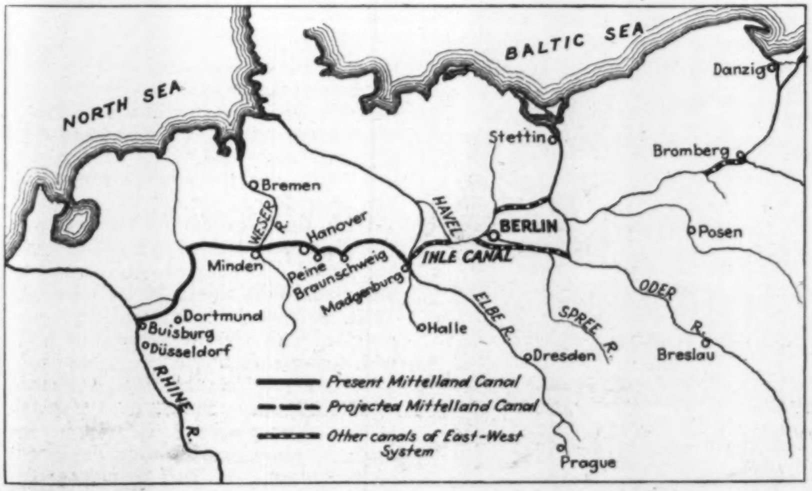
STEADY PROGRESS is being made on the principal navigation canal in Germany, the Mittelland Canal, which is intended to provide a connection from the Rhine to the Elbe. It is a 1,000-ton barge canal 11½ ft. deep.

Begun nearly 25 years ago, the canal was completed from the Rhine to the city of Hanover before the war and has been in operation on this section since 1914. After the close of the war the construction was continued, and operation to Peine was inaugurated. Further extension to Braunschweig is now under construction and is to be completed next year. From this point a link of 44 miles to the Elbe remains, aside from some extensions connecting with the canal network to the east.

Its essential purpose is to provide water connection from the industrial districts of the west to the regions of Berlin, Saxony and Silesia. Together with existing canals it will form an east-west waterway system, in conjunction with which the north-south waterway provided by the principal rivers (Rhine, Weser, Elbe and Oder) will form a complete gridiron of waterways throughout the country.

The canal will cross the Elbe River by an aqueduct 60 ft. above river level and about 3,000 ft. long. The approach embankment of this bridge is projected as hydraulic fill of sandy gravel carried up to a height of 65 ft., through which the bed of the canal will be sealed by a 2-ft. layer of clay rolled in place. Connection with the river and with the canal will be by mechanical lifts.

The Mittelland Canal forms a link in an east-west canal system connecting the north-south system of the Rhine valley with the Baltic Sea.

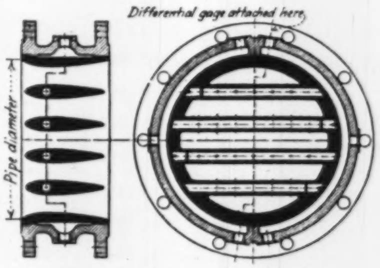


◆

Grid Flow-Meter Shows Low Loss of Head

A grid flow-meter developed by Prof. E. Schmidt, of Danzig, with a view to reducing the large loss of head occurring in orifice flow-meters without sacrifice of compactness, gave excellent results in recent tests, the designer reports in *Zeitschrift des Vereines Deutscher Ingenieure* of Dec. 19, 1931, p. 1,535. The loss of head was found to be even less than that of a venturi meter.

The new meter consists of a throat-piece, the clear opening of which is divided into several passages by horizontal grid bars of streamline cross-section. In the passages between these bars a pressure drop like that in a venturi meter occurs, the drop being regained in the downstream enlargement. Entrance pressure is received by openings at the upstream ends of alternate bars, and throat pressure by lateral openings in the intermediate bars. External ring passages transmit these pressures to a differential gage.



Four-bar grid flow-meter 14 in. in diameter, one of a group that showed low loss of head in tests.

Tests of grid meters of 14- and 16-in. pipe diameter with throat area ratios of 0.48 to 0.64 at flow velocities of 9 to 12 ft. per second showed the loss of head to range from 5½ to 10 per cent for the several meters. For any one meter it varied only slightly throughout a range from one-fifth to nearly twice the above velocity. The meter will be built by Bopp & Reuther, of Mannheim.

Stronger Concrete Pavement by Rapid Tamping

Tamping screed, striking 3,500 blows a minute, flushes 1-in.-slump concrete perfectly into forms with gain in strength and reduction in labor

By C. E. Meyers
Consulting Engineer, Philadelphia, Pa.

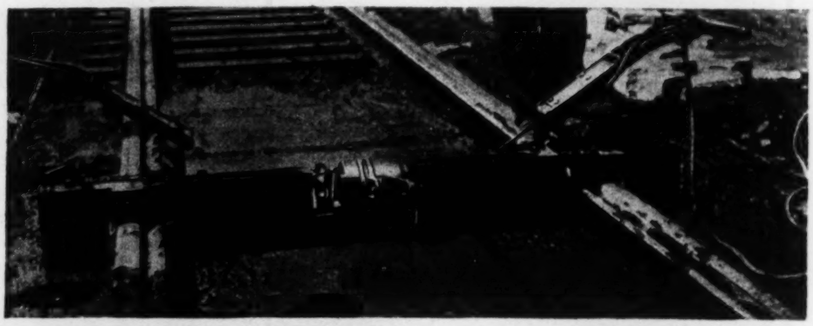
Tests made in 1931 by the Bureau of Public Roads in collaboration with the Port of New York Authority indicated that the strength of concrete was increased by high-speed tamping or vibrating of the pavement slab. With all other conditions alike, lengths of pavement were constructed by ordinary hand-placement, by tamping with pneumatic hammers striking 1,200 blows a minute, by Vibrolithic equipment giving about 2,000 vibrations a minute and by an electric vibrator giving 3,500 a minute. Core tests showed that the two methods giving the most rapid vibrations produced the stronger concrete. In this article the author, a prominent pavement authority, describes further tests of the high-speed electric vibrator in actual road-building. The results merit attention.
—Editor.

Within the past year there has been in course of development a new method for placing roadway concrete by the application of high-frequency vibrations. In placing a roadway slab it is clear that vibration can be imparted to the concrete only by application to the top surface. The new method consists, therefore, of subjecting the screed or strike-off board to high-frequency vibrations, so that the concrete is intensely vibrated simultaneously with placement. The concrete, even though it has a slump of less than 1 in., becomes plastic, tends to flow to position and expels entrapped air.

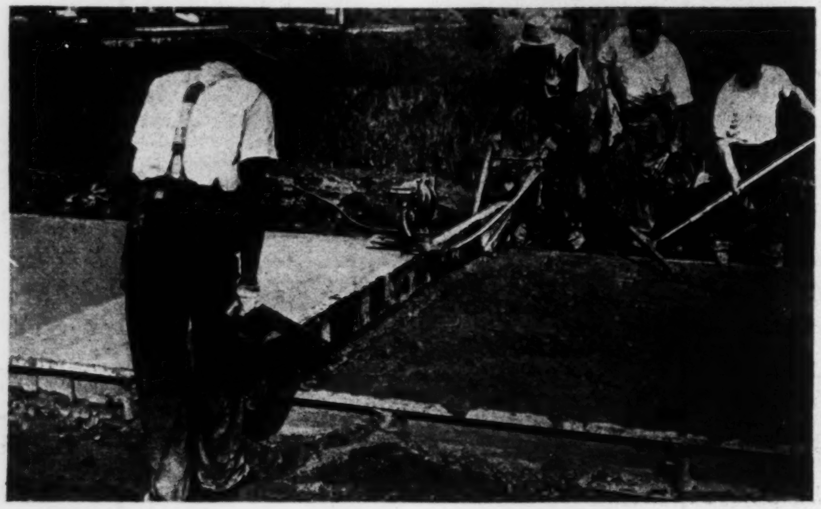
Car-track base

The vibrating strike-off board was tried first in Philadelphia on track construction. The apparatus consisted of a 4x10-in. wood beam about 8 ft. long. It was notched over the rails so that its lower edge was at the proper elevation for the concrete base, 6 in. below the railhead, for a granite block surface. Hinged fillers were provided so that, when in place, the screed hugged the webs of the rails. An electric vibrator, operating at about 3,500 r.p.m., was mounted in the center of the beam. Handles were provided to move the screed forward and backward.

Concrete was deposited in the track area and roughly leveled off somewhat above grade line for the base. The vibrating screed was then brought up, riding on the rails. The concrete was seen to flow down between the ties, under the bottom flanges of the rails and tightly against the webs, while the surface left after the passage of the screed was smooth and clean, requiring no hand-finishing. Cores showed that the concrete was tightly embedded against the wooden ties and that it was extremely dense. Two cuts were usually taken.



Vibrator and screed laying pavement base between rails of street-car track. Surface is produced by first of two passes.



Second pass of vibrating screed laying a 10-ft. 9:7:9-in. slab on Philadelphia street.

Philadelphia pavement

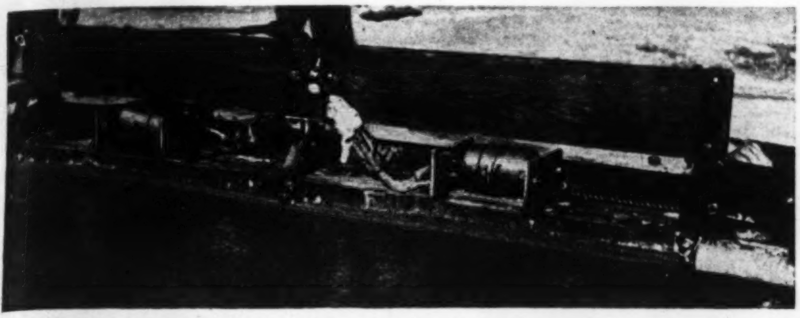
About this same time a concrete pavement 18 ft. wide built in halves was being constructed by the city of Philadelphia. The subgrade was clay, too wet to allow the use of the ordinary finishing machine. The contractor was using a hand screed made from a 3x8-in. plank, having plow handles at each end. Its use required four men.

A high-speed vibrator was attached to the strike-off board at its center. The concrete immediately became plastic. On the first pass the concrete was slightly wavy and some scratches developed, but on the second cut these waves were eliminated, the scratches disappeared and the surface that remained was so perfect that hand-rolling was omitted. Cores from this concrete were dense and in the crushing tests were well above the average for hand-placed concrete

Traffic-circle pavement

In October, 1932, the New Jersey state highway commission had a large traffic circle under construction about 30 miles east of Camden. On account of curves and of slabs with wide or narrow ends, it was impossible to use a finishing machine. A low water-cement ratio was required, and the concrete was extremely stiff. To strike off the slab, the contractor had three heavy metal screeds and eight men to operate them. The normal width of the slab was 10 ft., and the average production was about 600 ft. per day.

With the approval of the highway officials, it was decided to try the vibrating screed. The screed consisted of an oak plank 4 in. thick, 14 in. wide and 12 ft. long, and its forward edge was provided with a vertical face 8 in. high, with forward cutting edge rounded to a 2-in. radius. Two high-speed electric vibrators were mounted on the plank at the quarter-points. Provision was made for raising or lowering the crown of the plank. Flexible handles were



Heavy double-vibrator winch-hauled screed placing concrete on traffic circle on New Jersey highway.

provided, since the intense vibration would have made it impossible for the workmen to hold rigid handles.

A hand winch was utilized to propel the apparatus, which was too heavy for easy manipulation by hand. One man operated the winch and took care of moving it forward and handling the opposite pulling line as the work progressed. Two men manipulated the screed as it was pulled along by the winch. On superelevated curves the screed tended to work its way to the low side of the slab, the concrete also flowing to the low side. This was overcome by allowing the lower end of the screed to be advanced 2 or 3 ft. ahead of the high end, thus plowing the concrete toward the high side.

To finish the slab, it was necessary to utilize only one light hand screed to plane the surface to exact grade, after which the normal method of belting and brooming followed.

Whereas, with the original hand-methods, requiring eight men, only 600 ft. of slab could be completed in a day, the vibrating screed, operated with three men plus two for the finishing screed, placed an average of about 1,000 ft. of pavement in a day. This was about equal to the output of the finishing machines used on straightaway work on the same contract. The vibration of the side forms made it possible to eliminate two men previously utilized for spading.

With hand-finishing methods the concrete had been held to about 2½-in. slump. With the vibrating screed the slump was reduced to less than 1 in. The concrete was 1:1¾:3½, using gravel aggregate, and test cores averaged 5,408 lb. per sq.in. and showed some increase in density.

New York tests

In the same month the screed was tried out on two highway jobs being constructed for the New York state department of public works near Buffalo. On one job the clay subgrade was too soft to support a finishing machine, and the contractor had resorted to hand-finishing. When the vibrating screed was applied, the gravel concrete was immediately dried up to a 1-in. slump. On the second job the slab was being finished by a mechanical finisher. The vibrating screed was placed on the work ahead of the machine, and the concrete was dried up to about a 1-in. slump, the coarse aggregate here being crushed stone. The vibrating screed struck off the concrete to a satisfactory grade, and the finishing machine planed the surface off to exact grade. To test the ability of the machine finisher to handle such dry concrete, the vibrating screed was moved behind the machine. The concrete was much too dry to be handled by the machine, the surface concrete being torn and gouged. This arrangement was immediately abandoned, and the vibrating screed was again placed in front.

Test cores drilled showed an increase in crushing strength of 18 per cent for the vibrated concrete, and an increase in density was also apparent. On one contract the plain concrete crushed at 3,170 lb. and the vibrated concrete at 3,740 lb.

Direction

In Philadelphia the tests were conducted through the courtesy of Dudley T. Corning, chief of the bureau of highways, the contractors being the Union Paving Co. and the Eastern Asphalt Co. In New Jersey the work was under the supervision of J. W. Williams, district engineer of the New Jersey state highway commission, the contractor being Edw. H. Ellis, Inc. On the test near Buffalo the contractors were C. D. Ream, and Buck and Biscaro. The special equipment was devised by R. W. Baily and constructed by the Baily-Davis Corp., of Philadelphia.

Letters to the Editor

Sewer Charges or Tax Reform?

Sir—Your editorial "One Way to Cut Taxes" *(ENR,* June 2, 1932, p. 782) prompts the following remarks:

There are many of us who hold to the belief that whenever a water main or a gas main is laid near a city lot, that lot acquires additional value. The same applies when a school house is erected near by or a telephone or power line brings new conveniences within reach, or when transportation services are improved. Each such improvement brings to the lot owner an additional so-called unearned increment. It has become a practice, therefore, to let the cost of providing and operating certain utilities, such as streets and parks and playgrounds, fall upon the taxpayers. The collection and disposal of sewage, too, has heretofore been considered almost universally of such general community benefit, even when wastes from factories have to be cared for, that it is surprising to note a rising tendency toward the introduction of a sewage service charge.

The question deserves most careful consideration. It is always dangerous to burden unduly a special group. There are cities, for example, in Kansas and in Oklahoma and elsewhere in the United States in which there is no taxation by the local government. The entire cost of city government is met out of the profits of the municipal operation of public utilities. The rate payers contribute what should be collected from the taxpayers. The well-to-do capitalist and business man in these cities are favored at the cost of those who can least afford to pay. Are we now going to make those who connect with sewers also contribute to utility profits and thus to the cost of government, or should we not rather deal with the matter of tax reform, so that the cost of government will be fairly distributed? C. E. GRUNSKY.

San Francisco, Calif.,
June 7, 1932.

Money for Public Works, Orders for Industry

Sir—In your issue of June 9, p. 837, there is a letter by Joshua Barney entitled "Public Works or Relief." Mr. Barney's letter is based upon your publication of a "Program Sponsored by the American Society of Civil Engineers for the Creation of Employment and the Consequent Stimulation of Business."

The writer agrees with Mr. Barney that probably the most enthusiastic advocates of this plan would not agree to the delegation of the dictatorial powers which he states would be necessary. It is believed that Mr. Barney's premises—namely, those demanding immediately food, shelter and employment—are wrong. His argument states that: "Where needed public works may be promptly undertaken by communities that are able and willing to finance them, they will ultimately constitute a helpful factor for unemployment relief and business activity." It is believed that the proposition of the American Society of Civil Engineers contains exactly the same thought. Further, it insists that the work be properly designed and supervised.

Let us now return to this question of "immediate" relief. Last year in this city one reason for not advocating major projects was that it would take time to get them under way, whereas immediate relief was needed. This year we are hearing the same story; but if needed work had been designed last year and the funds voted last fall or winter, the work would now be in progress, the payment through the welfare board would have been materially reduced, and a large portion of the money now being given away as charity would be taking care of the interest and sinking fund of the bonds required to finance needed permanent improvements.

A short time ago an officer of a cement corporation informed me that their "bins were full;" that one-half million dollars of credit would do them little or no good, but that a bona fide order for fifty or one hundred thousand barrels of cement would start the mill immediately. Is not that the situation of manufacturers in many lines of business? They need orders, not money, and to enable their factories to resume operations the retail merchants or the contractors must have customers.

Mr. Barney is correct in stating that "Immediate relief is necessary," but there is a grave question as to whether it is better to provide charity jobs or straight money relief. In watching the progress of work carried on as an immediate relief proposition, investigation leads to the belief that the morale of the men employed on that work has been injured more than if they had received an outright dole. This, at least, is the opinion of some of the men interested in this subject.

The society did not request the starting of a huge volume of public works. It did suggest the continuance of a normal amount and quoted figures to show what the normal amount had been and also figures to show what was the amount being deferred. No permanent relief is going to be accomplished by fly-by-night jobs, or by giving away food cards, or by guaranteeing house rent by charitable organizations. So-called normality will not return until retail buying of food and clothes is resumed and a laborer's earnings cover not only these two necessities but also his rent and taxes.

Idle dollars do not earn more than idle men, and both must be put to work if earnings are to be produced. If there is any better method of doing this than that suggested by the engineering committee of the American Society of Civil Engineers, then the latter should be discarded; until such better method is discovered, it would appear to be the part of wisdom to try and find out how to make the existing proposal effective rather than to find out how it can be made ineffective. THERON M. RIPLEY.

Buffalo, N. Y.,
June 13, 1932.

Steel-Pile Bulkhead Wall

Sir—The excellent description of the steel-pile bulkhead wall in your issue of March 31, 1932, p. 468, has drawn the writer's attention to one or two points that may be of interest.

The use of steel piling in fresh water may be economical, but of this I have no personal knowledge. Its use in sea water is open to grave doubts. I have in mind a case where tierods passing through the sheetpiling to hold them in place suffered corrosion due to galvanic action, and within three years required immediate repair, it being necessary to weld by divers.

It is noted in the article referred to that *wrought-iron* tierods connect to the steel wales in the structure. Whether such action would take place in the work described on Lake Michigan remains to be seen.

It is interesting to note that in a report on the "Deterioration of Structures of Timber, Metal and Concrete Exposed to the Action of Sea Water" (interim) report, 1929, by the committee appointed by the Institution of Civil Engineers (London), Dr. Newton Friend states, in part, "The cold-blast metal proved slightly superior to hot-blast. When dissimilar metals were exposed in contact or riveted or bolted together, *one of the metals was preserved at the expense of the other.*"

Long Beach, Calif.,
April 28, 1932.
J. W. B. BLACKMAN.

Increased Public Construction Needed

Sir—The recent statement of the administration may stop the passage of a great bond issue directly for public works. Perhaps the alternative relief measures will be satisfactory, but there may be so much confusion as to what constitutes a self-sustaining project and the amount of this work may be so inadequate that you may wish to carry on your advocacy of a federal (or other public) construction program.

To provide any real relief, the program would have to be extensive. Otherwise it would replace only a fraction of the average yearly construction to which we have been accustomed for a decade, and that for a period of one year only.

There must be a relatively greater proportion of public construction in the future. This is because there is a very real limit to the possibilities of factory and commercial buildings, erected for profit; whereas, the residential field, great as its possibilities are, is not large enough to take up the productive capacity of the construction industry, nor can new residences be "consumed" fast enough to afford any large measure of relief. On the other hand, it is obvious that the people can consume services to an almost unlimited extent, and in so doing achieve a higher standard of living. These services are by their nature community enterprises. In the past few decades we have mentally and socially accommodated ourselves to paying a larger and larger part of our national income for these services. If we willingly pay out what we do for schools, hospitals, institutions, service bureaus, good roads, etc., it is entirely possible that we can adjust ourselves mentally to a further increase of this percentage, especially if we can be persuaded that it will bring employment, balance the present inequalities, and above all prevent something very much worse.

There are three ways in which these public services can be paid for: indirectly, by taxation, either all at once or spread out over a period of years; directly, as for example, by the tolls for a bridge; semi-directly, as for example, by the covering of road costs in Westchester County, N. Y., out of the receipts from amusement places. Post offices might be paid for (if they are not now) by a sufficiently high postal rate.

The public pays for these services ultimately in one way or another. It is merely a difference in method, arising from the distinction made by most people between $10 spent in taxes for services whose value seems remote at the moment, and the same sum spent for something whose value appears real and immediate.

So it becomes a matter of public education toward a more social attitude. This is perfectly consistent with individual liberty and is a question entirely of degree, as the tendency has been that way for a long time. The great majority of employed people does not care about those for whom relief is sought, because they always expect that someone else (the government in some way) will take care of it with someone else's money. But if the majority could be persuaded that their own security was dependent on community action, they would be glad to support it.

It seems to me that one of the important steps is the establishment of a 30-hour week in federal, state and municipal work. Actually what this does is to divide the work up at the expense of efficiency. Such a move would be permanent, while the effect of a bond issue might be only temporary. Such a move would have to be started by the government because of the obvious difficulty of any one concern in competitive industry starting it.

The argument that a large bond issue could be as readily absorbed now as were the Liberty Loans of 1917-1919 seems to me to be dangerous. Then we were rich from the European war orders, there was but little government indebtedness outstanding, we had unlimited confidence and the united purpose that a war produces. All these conditions are to-day reversed.

New York City,
June 4, 1932.
Carl F. Scott.

Straight-Line Concrete Formulas in Europe

Sir—Prof. Inge Lyse's article entitled "Cement-Water Ratio by Weight Proposed for Designing Concrete Mixes," (*ENR*, Nov. 5, 1931), seems to have aroused a good deal of interest. Prof. Lyse and the correspondents whose letters appeared in your February and March issues seem to be satisfied that the use of cement-water ratio by weight and the straight-line formula for concrete strength are completely new. Apparently they are not familiar with European concrete literature, in which reference to c/w by weight and straight-line formulas have been appearing for some years. The following are four notable publications of different types in which the straight-line relationship between w/c by weight and strength of concrete is discussed:

1. "Durcissement des Mortiers et Bétons," by J. Bolomey, professor at the University of Lausanne. Published in the *Bulletin Technique de la Suisse Romande*, Nos. 16, 22, 24, 1927. This contains a reference to an earlier publication in 1925, dealing among other things with a straight-line formula.
2. "Résistances des Bétons au Choc, à l'Usure et au Décollement, Comparées à Leurs Résistances à la Compression, à la Flexion, et à la Traction." By R. Feret (Boulogne-sur-Mer). Published in *La Revue de Construction et de Travaux Publics* (Paris). March to October, 1929.
3. "Le Contrôle du Béton Sur les Chantiers," by J. Bolomey. Published in *La Houille Blanche* (Grenoble). November-December, 1930.
4. "Le Ciment Portland Artificiel—Fabrication—Propriétés. Mortiers et Bétons." Published by Le Groupement Professional des Fabricantes de Ciment Portland Artificiel De Belgique. Second Edition, 1930 (Brussels).

The first and second of these deal with results of original researches and have aroused considerable interest among specialists in Europe. The third is an article on the control of concrete on the job, published by a journal devoted to hydro-electric engineering. The fourth is a handbook for the concrete user—a semi-popular type of publication —published by a Belgian association of cement manufacturers.

In view of the dates of these publications, their countries of origin, their varied appeals and the probability that abstracts of some of them have appeared in other languages, it must be admitted that the value of using c/w by weight and the straight-line relation have been widely known, at least in Europe.

In his 1925 paper Bolomey published a straight-line formula based on the work of Feret, Fuller and Thompson, Young, Williams, Abrams and his own experiments. This formula, with two of the symbols altered, reads:

$$S = (c/w - 0.50)\,K \qquad (1)$$

where K is a variable coefficient depending on the cement and the conditions of curing. For normal concretes K lies between 1,600 and 1,700 lb. per sq.in.

Results of compression tests of mortars are published in Bolomey's 1927 paper. He found that the strength of some mortars appeared to depend solely on c/w. However, for tests in which different sands, including standard sand, were used, the relation of strength to c/w was not so definite. He ascribes the discrepancy to the combined effects of porosity and compactness (absolute volume of solids in unit volume of mortar). Recognizing the difficulties of measuring these quantities, he showed that it was possible to take account of them on the job by measuring a quantity that is affected by both of them—namely, the density or weight per unit volume of the freshly made mortar. To allow for the porosity and compactness he used the square of the ratio of the density to a density-type figure, which he chose as 2.35 grams per cubic centimeter (146.6 lb. per cubic foot). His formula, with symbols and units changed, reads:

$$S = \left[\left(\frac{\Delta}{146.6}\right) c/w - 0.50\right] K \ldots (2)$$

where Δ = weight, in pounds per cubic foot, of the fresh concrete.

For mortars made with well-graded aggregates Δ is about 146.6 lb. per cubic foot, and the formula reduces to the simpler form of Equation (1):

$$S = (c/w - 0.50)\,K \ldots\ldots\ldots$$

This is a particular form of a more general and widely used formula for concrete.

$$S = (c/w - A)\,K \ldots\ldots (3)$$

K and A can be determined most conveniently for a particular job by making preliminary tests of concretes having different cement-water ratios. Then insert the known values of c/w and S in Equation (3) and solve for K and A.

It is worth noting that most of the formulas for the strength of concrete in terms of either c/w or w/c by weight are anticipated by a particular case of Feret's early formula, in which strength is expressed as a function of $c/(w + v)$,

where c = absolute volume of cement per unit volume of concrete
w = volume of water (or weight in metric units) per unit volume of concrete; and
v = voids per unit volume of concrete.

For good workable concrete v approaches zero, so that Feret's expression then becomes a function of c/w.

In this connection an article entitled: "Liants Hydrauliques, Mortiers et Bétons," by R. Feret, is worth reading. It was published in *Les Annales des Ponts et Chaussées*, 1931, part 2, pp. 89-112. It has a special interest for American readers.

H. W. Walsh,
Professor of Civil Engineering,
University College.
Cork, Ireland,
April 25, 1932.

Pay as You Go

Sir — The public-works doctrine, which you have espoused, would be a splendid cure for our economic ills, were it not for the fact that the work is to be carried on with borrowed money. Those who advocate such a plan—unless they are stone blind—must deliberately close their eyes to the fact that one of the major causes of the present economic plight of the world is to be found in the policy that has been in vogue for about a generation of borrowing money for all kinds of work, to be repaid some time in the future—which never really happens, as new loans are immediately taken up. Whereas, the safe and sane policy is to "pay as you go."

The greatest objection to the policy of borrowing lies in the temptation to overdevelop, which has been indulged in very freely. The whole economic structure has thus gotten out of balance.

To continue this mad policy, as you propose, is not going to act like a magic wand and cure the situation, although it may cause a brief flare-up of prosperity —a last wild orgy of spending before the final collapse.

If the public-works policy is to be a success and a cure, the work must be carried on a basis of pay as you go. Those who have work must either divide it up with those who have not, working part time for proportionate pay, or they must give up a very large percentage of their wages to be used to carry on the public-works policy.

In either case, will the nominal purchasing power of the individual who gives up part of his wages be reduced, and that of the individual who gains employment be increased by the corresponding amount? Prices will be forced down naturally, and gradually things will adjust themselves, if man does not interfere foolishly.

If instead of preaching—as has been done—that prices and (nominal) wages must not come down, the natural process of adjusting supply to demand had been permitted to work itself out, we would not be nearly so badly off as we are today, and we should not be facing a collapse but merely going through a drastic retrenchment.

Baltimore, Md.,
May 24, 1932.
R. Reimann.

NEWS OF THE WEEK

Leaking Gas Main Blamed for Wreck of Columbus Building

A LEAKING gas main of the Columbus Gas & Fuel Co. was the cause of the explosion on April 14 which partially wrecked the Ohio state office building at Columbus a few weeks before it was to have been put into use, Attorney General Gilbert Bettman has reported to the Ohio state office building commission after weeks of investigation.

The commission authorized Bettman to institute suit for the recovery of full damages. According to the report, the state has claims against the gas company and against the contractors and their surety companies. The contractors and the surety concerns denied liability following the explosion and refused to complete the building without further compensation.

The attorney general advised the commission of steps necessary for the completion of the building by contractors already having contracts for construction of the building, without prejudice to the state's claim against the contractors or their surety. The report also covered the method of financing the restoration through issuance of certificates of indebtedness under a recent act of the state legislature.

The explosion caused loss of ten lives, injuries to two score persons, and monetary loss variously estimated at from $750,000 to $1,000,000 (*ENR* April 21, p. 597.) The building's entire cost was between $5,000,000 and $6,000,000.

Gas company officials declared that the force of the explosion caused the leak in the main.

◆

Speedy Completion of River and Harbor Work Urged

Completion of authorized flood control work and river and harbor projects in the shortest time consistent with sound and economical construction methods was urged upon both national political parties by the National Rivers and Harbors Congress at a special convention held in Chicago June 13-14. The resolution adopted by the congress states that increasing the rate of construction will give the public the benefit of these facilities in from one-third to one-half the time required under the present system of annual appropriations, will save 25 to 30 per cent on costs over the "present rather haphazard annual appropriation system" and will transform partly completed projects from a liability to an asset.

More than 1,000 people attended the convention. Before it adjourned a rising vote of thanks was extended Major Gen. Lytle Brown, Chief of Engineers, for his action in entering into an agreement under which the first section of guide-line levees would be built in the Atchafalaya basin, cutting off Bayou Courtableau, thereby giving protection to 250,000 acres in St. Landry parish.

Source of Skilled Labor on Road Work May Not Be Limited

States may not restrict skilled labor on federal-aid highway work to residents of the state, according to a ruling received by the New Jersey State Highway Commission. Under a policy outlined by the U. S. Bureau of Public Roads, a state may give preference to residents of the state in unskilled labor, but such limitations are not permitted in the case of skilled labor.

◆

New Triangulation Survey To Be Run on Atlantic Coast

A new arc of triangulation to extend along the coast of Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, and Virginia, has just been started at Providence, R. I. The survey will establish triangulation stations at 10-mile intervals for the accurate determination of boundary lines and for other engineering operations. The work is being carried out by the Coast and Geodetic Survey and is expected to be completed to Norfolk, Va., by the fall of this year. For use in the flat country, portable steel towers to a maximum height of 129 ft., are to be employed. They are designed for movement by trucks from point to point.

Prevailing Wage Law of Texas Declared Unconstitutional

THE LABOR statute of Texas requiring contractors on public works to pay hourly wage scales current in the locality of construction was declared unconstitutional by decision of a three-judge federal court at Austin. The decision climaxed a wage controversy of some months' standing in which four contractors for the construction of buildings at the University of Texas sued first for a temporary and later for a permanent restraining order against R. B. Gragg, state labor commissioner, and Bryan Blalock, county attorney of Travis County, to prevent their enforcing the state wage scale statute.

The plaintiff contractors were P. O'B. Montgomery, Christi-Dolf, and the Bellows-Maclay Construction Company, all of Dallas, and the Graham-Collins Electric Co. of San Antonio, holding contracts on construction of six buildings on the University campus, costing more than $3,000,000.

The opinion written by Circuit Judge J. C. Hutcheson, Jr., of Houston and concurred in by District Judge R. J. McMillan of San Antonio and District Judge

Monard Flyers, Inc.

SPORT ARENA BUILT IN EIGHT WEEKS

The principal preliminary to the Sharkey-Schmeling boxing match for the world's heavyweight championship was an eight-weeks' fight to complete the 72,000 seat arena known as the Madison Square Garden Bowl. Located in Long Island City, an industrial section of New York City, the bowl is octagonal in shape, 307 ft. wide and 370 ft. long. The original ground surface sloped about 17 ft. in the 307-ft. width, and the cut-and-fill operations required to form the bowl involved the handling of 90,000 cu.yd. of excavation, largely sand. The resulting embankment is 7 ft. high on the near side, increasing to 25 ft. on the far side. The entire interior (about 50,000 sq.yd.), after rolling and compacting, was paved with 2 in. of asphalt. Seats are of wood supported on special malleable-iron castings anchored into the embankment. Ramps lead up to a promenade on top of the embankment from which aisles converge toward the ring. Drainage is handled by a catchbasin in the center of the bowl. One-story fireproof buildings, totaling about 1,000 ft. in length, and containing dressing-rooms, offices and concessions are placed at the four corners. Steel frames with roofs and walls of corrugated asbestos are used. Some 2,000 lin.ft. of fence of the same material completes the inclosure.

The bowl is owned by the Madison Square Garden Corp., William F. Carey president, and was designed by Emil Praeger and J. C. Baxter, of Carey, Baxter & Kennedy, engineers and contractors. William P. McDonald, Flushing, N. Y., had the general contract and sublet the excavation to Slattery Contracting Co.

Duval West of San Antonio, declared Article 1,580 of the penal code of Texas violative of the Fourteenth Amendment of the Constitution of the United States. Article 1,580 provides, among other things that all contractors on government work shall pay to labor on such work the hourly wage current in the locality, the penalty being a fine of from $100 to $500 and imprisonment not exceeding a year. Unconstitutionality was determined on the grounds that the article "is indefinite, uncertain, and does not define the hourly wage, thus violating the Fourteenth Amendment by requiring contractors to pay what is not defined," counsel for the contractors, stated.

The contractors bid on the University buildings, it was explained, on the assumption that carpenters could be obtained at $5 a day, labor at 25 cents an hour, and electricians at $7 a day, because there were numbers of workmen who proposed to take the jobs for less. State Labor Commissioner Gragg entered complaint on these conditions and in accordance with figures gathered at an open hearing sought to require a wage scale of $7 a day for carpenters and a corresponding increase for others.

◆

Hoover Dam Notes

The first arch-section concrete to be placed in the lining of Hoover Dam diversion tunnels was poured during the week ended June 11 in the upper end of tunnel No. 4. During the week 580 ft. of invert and 527 ft. of sidewalls were poured in tunnels 2, 3 and 4. To date there has been placed in these tunnels a total of 4,446 ft. of invert, 2,585 ft. of sidewalls and 40 ft. of arch.

Excavation continued during the week on both spillway open cuts and on the enlarging of tunnel No. 4 for the upper tunnel plug.

* * *

Studies and cost estimates for handling steel penstocks in the diversion tunnels were completed. A preliminary draft of specifications for the turbines and governors was sent to interested parties for comment and a preliminary draft for generators and transformers has been started. Testing to determine the bend losses in the outlet works and power penstocks is in progress at the hydraulic laboratory at Ft. Collins, Colo.

* * *

At the Hoover Dam laboratory 20 tests at 8-hours age and 63 at 28-days age were made of concrete from tunnel lining. Average compressive strengths were, respectively, 1,210 and 3,785 lb. per sq.in. Thirty 6x12-in. cylinders were mixed and placed in the tunnel lining. Fifteen of these will be cured with the Hunt process, and the remainder by usual water spraying. Tests will be made of these specimens at 7 to 90 days age. Two sets of thermometer wells have been placed in each side and temperature readings have been taken in all holes each shaft.

* * *

The fatality record to date has been one death for each 213,620 man hours. The labor turnover in May numbered 745 men time-checked and 275 men hired. Since Six Companies Inc. started work, 6,434 men have been hired and of the 2,753 men working for the company and its subcontractors on May 31, 47 per cent were ex-service men.

City Water Department Bids Low on Hetch-Hetchy Work

The $5,257,665 bid of the San Francisco Water Department on the job of completing the Hetch-Hetchy aqueduct was the lowest received by the city when bids were opened recently. The next lowest bidder was the firm of Lindgren & Swinerton with a bid of $5,815,335. The matter of the award of the contract is now before the Public Utilities Commission, award of the contract to the Water Department being protested by the private bidders on the ground that the city department had an advantage in not being required to post a bond for performance of contract.

◆

Engineers Propose Tax Reforms for Chicago District

THE seriousness of the tax situation in the Chicago metropolitan district has claimed the attention of the Western Society of Engineers for several months and a report on the subject recently made public recommends the reorganization of local government in Cook County and the formation immediately of a governmental and taxation council. The main point in the program recommended for the council includes a professional engineering survey and report to furnish the fundamental facts needed to safely reduce taxes. Other points in the recommended program are as follows:

Determination of a plan for the simplification of local government and a review of the desirability of having but one local government in Cook County.

Determination of a reasonable maximum per-capita tax and cost for local government and a plan for scientific budgetary control.

Determination of proper per-capita bonding limits, including all special assessments, until the city is on a cash basis.

Determination with respect to local governments of necessary functions, functions better operated privately, functions to be paid for by direct tax or by service or license fees.

Drafting of a charter for a new local government and securing the enabling legislation to put it into effect.

Simplifying the ballot.

It is believed that a simplified government can provide within a reasonably short time a scale of taxation which will make the community increasingly attractive to business enterprise.

The body of the report contains a complete discussion of the local tax situation of Chicago and Cook County, including expenditures, debts and the causes of high costs which are attributed to lack of equal representation in Congress, in the state legislature and in the city council, to the large number (400) of governing bodies, to the excessive number of departments, divisions and bureaus in the city, to separate governing bodies, to lack of budgetary control, to the large number of governmental functions and to inefficiency of politically elected officials. The excellent work done by competent engineers in public service is recognized. The report states that, in addition to design, construction, maintenance and operation, the determination of policy should be recognized as engineering.

Members of the Taxation Committee which formulated the report are John W. Alvord, D. J. Brumley, H. A. Carter, H. S. Cutmore, J. DeN. Macomb, C. C. Whittier and W. A. Van Hook, chairman.

◆

Navy and Army Officers Win Arc Welding Competition

In the second arc welding prize competition sponsored by the Lincoln Electric Co., Cleveland, Ohio, Lt. Com. Homer N. Wallin, and Lt. Henry A Schade, C.E.C., U. S. Navy, Mare Island Navy Yard, were awarded first prize of $7,500 for their paper entitled "The Design and Construction of an Arc Welded Naval Auxiliary Vessel." Major G. M. Barnes, chief of design and enginering, Ordnance Department, Watertown Arsenal, won secod prize of $3,500 for his paper, "Manufacture of Ordnance at Watertown Arsenal Revolutionized Through Arc Welding." The third prize of $1,500 was won by H. H. Tracy, structural engineer of the Southern California Edison Co. Ltd. of Los Angeles for his paper on "The Application of Arc Welding to the Design of Steel Buildings for the Resistance of Earthquake Forces." A $750 fourth award went to Gustav F. D. Wahl and Harry E. Johns, Kiel, Germany, for a paper on a special river-sea bulk cargo ship. H. J. L. Bruff of Harrowgate, England, won fifth prize of $500 for his paper entitled "Strengthening Weak Iron and Steel Bridges by Arc Welding." A paper on welding steel cars won $250 for William H. Zorn, Wyandotte, Mich. Thirty-five other papers were awarded prizes of $100 each.

◆

Cleveland Engineer Relief Farm Makes Slow Progress at Start

To carry on the farm and other relief projects for unemployed engineers in the Cleveland area, the Technical Men's Relief Association has been formed, with Ray T. Baylies as president. So far only 20 acres have been put under cultivation and only about $1,500 of $20,000 needed has been subscribed. Ten men so far have actually started to work on the farm project.

The original plan has been somewhat revised. With 1,300 technical men out of work it was hoped sufficient funds could be raised immediately to employ hundreds on the farm. But seed and fertilizer have taken several hundred dollars, and those actually employed on the farm are being paid 50 cents a day plus food and lodging, so funds are inadequate even for the farm plan. To raise needed funds men will be paid to solicit the entire membership of the 14 Cleveland engineering societies. From funds thus raised a filling station and garage for repair work will be built.

The farm plan originally set up is departed from in another particular as subscriptions first were solicited with the understanding that at harvest time subscribers would be entitled to at least $5.00 worth of vegetables. Now, outright donations will be asked for, since it is probable that the entire production of the farm can be used for the relief of unemployed engineers during the coming winter.

Bids Received for Penstocks for Hoover Dam

BIDS for the fabrication of the steel penstocks and outlet pipes for Hoover Dam, estimated at a total of 100,000,000 lb., were opened by the Bureau of Reclamation on June 15 at the Denver office. Bids are stated to range from $13,624,868 to $9,270,000, the bid of Babcock & Wilcox of Barberton, Ohio, being the lowest. No award of the contract is expected until about July 1 as twelve schedules are involved in the bidding. Three different designs were included in the specifications, two methods of erection and two methods of shipment. The designs covered pipes 30, $17\frac{1}{2}$ and 13 ft. in diameter, with layouts to suit each size, and the methods of erection gave the bidder a choice of having the pipe delivered at the adits and portals of the penstock tunnels by the government from the railway line on the canyon wall or delivered within the tunnels within 1 ft. of final location. The government is building a cableway across the canyon for delivery of material in the canyon to supplant the incline railway projected in the original plans for the development. Shipment from the manufacturer's plant may be by commercial bills of lading or by the government, delivery being made at the plant.

The contract calls for "furnishing labor and materials and performing all work for furnishing, erecting and painting plate-steel outlet pipes with branch connections, wye branches, and manifolds in concrete lined tunnels at Hoover Dam." Plate thicknesses range from $\frac{7}{8}$ in. to $2\frac{15}{16}$ in.

◆

Toledo Sewage Treatment Plant Starts Operation

Operation of Toledo's new $2,000,000 sewage treatment plant was started on June 8. The plant was completed in the closing weeks of 1931 but because of the financial difficulties of the city it was not thought possible to incur the expenses of operation. In the meanwhile the state health department has insisted upon its use to prevent the pollution of the Maumee River and bay.

The new plant is of the separate-sludge-digestion type. A description appeared in *Engineering News-Record* of March 5, 1931, p. 389. Toledo's financial difficulties and its effect in delaying the operation of the new plant were recounted in *Engineering News-Record* of Feb. 25, 1932, p. 277.

◆

Pine Canyon Dam Costs Lowered

Readjusted estimates for the cost of the Pine Canyon Dam of the city of Pasadena, Calif., as announced by Samuel B. Morris, chief engineer of the Pasadena water department, show that present conditions will permit the carrying out of the entire plan at a cost of $3,350,000 less than the original estimates. The lowered cost partially is due to the reduction in height of the proposed dam. The project as launched several years ago had an estimated cost of $10,850,000. The revised estimate is $7,500,000.

Floating Drydock Badly Damaged by Two Explosions

Explosions, one of which is reported to have occurred within the drydock itself and one within a ship under repair in the drydock, seriously damaged the Vickers' floating drydock at Montreal and the oil tanker Cymbeline which was undergoing repairs in the drydock following grounding in the St. Lawrence River. Accurate details are lacking because so many of the workmen were either killed or seriously injured. First reports stated that both explosions occurred within the tanker but subsequent investigation is stated to indicate that the first explosion may have occurred within the drydock itself and that the subsequent fire caused the second major explosion, occurring about an hour later, which so badly damaged the tanker and caused additional deaths.

The Vickers' drydock was built in England in 1912 and towed across the Atlantic Ocean to Montreal.

Soviet Order Start on Big Power and Irrigation Projects

Start of construction on three projects for power and irrigation on the Volga River in Russia has been ordered by the Soviet government. The first dam to be constructed will be at Kamishin in the lower Volga region to supply power to the steel and railway car plant at Nizhni Tagil.

Recently the Central Volga Construction Bureau headed by A. V. Winter, who was in charge of the construction of the dam and power plant on the Dneiper River, was organized. Prof. I. E. Alexandrov, designing engineer on the Dneiper River work, will be in charge of designs on the new projects. The staff from the Dneiper project is gradually being transferred to the Volga project.

Plans for the three power stations are being prepared by the Energocenter (power center) and are to be ready by Oct. 1 of this year.

Idaho Tax Upon the Generation of Electricity Upheld

A SUIT brought by the Utah Power & Light Co. to enjoin the enforcement of an act passed by the Idaho legislature in 1931 levying a license tax on the generation of electricity within the state, for sale or exchange, was upheld by the United States Supreme Court on May 16. The tax provides that any individual or corporation engaged in the generation of electricity must pay a license tax of one-half mill per kilowatt-hour measured at the place of production. All energy used for pumping water for irrigation purposes within the state is exempt from the provisions of the act except where the water so pumped is sold or rented to such irrigated land, provided the exemption shall accrue to the benefit of the consumer.

The tax was assailed on several grounds, the principal one being that it imposed a direct burden on interstate commerce. The power company contended that the tax is not one on manufacture or production, but on the transfer or conveyance of energy in nature from its source to its place of use; that the energy is brought to the consumer in Utah directly from its source in the waterfalls in Idaho. Thus the generator is an instrumentality of interstate commerce and the process of generation is simultaneous and interdependent with that of transmission and use. The state, in defending the suit, claimed that the tax is laid on the generation of electrical energy as a distinct act of production and without regard to its subsequent transmission; that the process of generation is one of converting mechanical energy into electrical form; that the resulting change is substantial and is a change in the physical characteristics of the energy; that the generation of the electrical energy is local, and only its transmission is interstate commerce.

Upon these contentions the Supreme Court said, "From the strictly scientific point of view, the subject is highly technical, but in considering the case we must not lose sight of the fact that taxation is a practical matter and that what constitutes commerce, manufacture or production is to be determined upon practical considerations. Electrical energy has characteristics clearly differentiating it from the various other forms of energy, such as chemical energy, and the energy of falling water. Appellant here, by means of what are called generators, converts the mechanical energy of falling water into electrical energy. Thus by the application of human skill a distinct product is brought into being and transmitted to the place of use. The result is not merely transmission; nor is it transmission of the mechanical energy of falling water to place of consumption; but it is, first, conversion of that form of energy into something else, and, second, the transmission of that something else to the consumer. While conversion and transmission are substantially instantaneous, they, are we are convinced, essentially separable and distinct operations. The process by which the mechanical energy of falling water is converted into electrical energy, despite its changed character, is no less real than the conversion of wheat into flour at the mill.

"We are satisfied that the process of generation is as essentially local as though electrical energy were a physical thing; and to that situation we must apply the general rule that commerce does not begin until manufacture is finished, and hence the commerce clause of the constitution does not prevent the state from exercising exclusive control over the manufacture.

"Without regard to the apparent continuity of the movement, appellant, in effect, is engaged in two activities, not in only one. So far as it produces electrical energy in Idaho, its business is purely intrastate, subject to state taxation and control. In transmitting the product across the state line into Utah, appellant is engaged in interstate commerce, and state legislation in respect thereof is subject to the paramount authority of the commerce clause of the federal constitution."

Construction Work on Dotsero Cutoff Again Postponed

DECLARING that the public interest is paramount to the financial condition of the Denver and Rio Grande Western, the Interstate Commerce Commission has served notice on the road that it must commence construction of the Dotsero cutoff by Sept. 15. In a recent petition the company asked for an extension of time until March 15, 1933, or if that is denied, sufficient time at least in which to submit application for a loan from the Reconstruction Finance Corporation. The road advised the commission that it was loath to assume such an obligation under present conditions but protested the sincerity of its desire to proceed with the project. In its report limiting the extension to three months from June 15, the commission said that no effort had been made by the Rio Grande Company to act under its authorization since the granting of the previous extension and that the company had given no assurance that it would be able to proceed with the work March 15 next year if an extension to that date were granted.

Explaining that the short extension was granted to give the road, the Moffat Tunnel Improvement District and other parties an opportunity to confer with a view to bringing the plan to fruition the commission said it would stand ready to lend its good offices to that end. Commissioners Mahaffie, Eastman and McManamy protested that the Rio Grande already had had a good deal of time and had not made good. They favored revoking the authorization given to the road to undertake the project so that other interests might have a chance.

When the Denver & Rio Grande Western Railroad applied to the Interstate Commerce Commission for authority to acquire control of the Denver & Salt Lake Railroad by capital stock purchase the commission made its approval conditioned upon the purchase of minority stock of the railroad company offered to it at $155 a share and the construction of the Dotsero cut-off linking the D.&R.G.W. with the D.&S.L. west of the Moffat tunnel. It was for an extension of the time limit on these conditions that the railroad applied to the commission.

One obstacle to the construction of the cutoff was removed on June 18 when the federal court at Wilmington, Del., dismissed a complaint filed by the Moffat Tunnel League and others against the Interstate Commerce Commission's order permitting the D.&R.G.W. to purchase the Denver & Salt Lake R.R.

◆

Grant of Public Land For Los Angeles Aqueduct Approved

The United States Senate, on June 15, passed and forwarded to the President for signature a bill transferring to the Metropolitan Water District of Southern California land necessary for the right-of-way in building its aqueduct from the Colorado River to the cities in the Los Angeles region. The aqueduct, for a considerable part of its length, will traverse public lands. For details of the aqueduct see page 847 of last week's issue.

Brief News

The Ability of Contractors and their sureties to carry out their contracts is to be studied by the Ohio State Highway Department before contracts are let. A new credit division has been established within the department for this purpose.

Concentration of All Gas-Tax Money on highway work alone and a reduction of the gas tax from four to three cents is proposed by the Gasoline Taxpayers Association of Colorado. The association would include this in a constitutional amendment.

A Subway for Street Cars in downtown Pittsburgh would permit an increase of from 38 to 45 per cent in traffic in that section and would produce the same result as a bypass loop around the "Golden Triangle," according to a report by Lewis W. McIntyre, city traffic engineer.

An Experimental Road 7 miles long with a "retread" surface is to be built by the Missouri State Highway Commission between Unionville, Mo., and the Iowa state line for the purpose of ascertaining how such construction will stand up under frost and ice of the northern section of Missouri.

Construction of a New Building to house the health, hospital and sanitation departments of New York City at a cost of $3,674,000 has been approved by the city. The building will form a unit in the new civic center being developed by the city. Foundations for the building were completed some time ago.

Three Incinerators, to cost $962,000, are to be built by New York City as part of its program to end the dumping of garbage at sea. Such dumping was ordered to cease by July 1933, in an order of the U. S. Supreme Court following complaint from New Jersey.

Construction of a $700,000 municipal power plant at Piqua, Ohio, was approved by the city commission on June 7. A bond issue to cover the cost of the plant was approved by the voters last November. Contracts for mechanical equipment have already been let and it is expected that contract for the building will be awarded some time in July.

A Controlled Spillway at Old River as a means of preventing the formation of sand bars in the Mississippi River and of conserving the reservoir capacity of the Atchafalaya River as well as protecting bottom land from annual overflow is advocated by the Louisiana State Board of Engineers in its biennial report to the state legislature. Harry Jacobs is chief engineer of the State Board.

Formation of a Power District, the first one to be formed in Clallam County, Washington, under the laws of 1930, is being petitioned for by residents of the territory west of Port Angeles, Wash., including the Elwha, Edgewater, Eden, Freshwater and Joyce districts. The law of 1930, generally known as the power bill, authorized rural districts to form public utility districts and to furnish water and power to their residents. The proposed district is to furnish light and power. A local company, formed by residents, is now retailing power to part of the area named in the petition.

Alleged Employment of Aliens in the replacement of the South Michigan Ave. bridge, Buffalo, N. Y., has caused the Wisconsin Bridge and Iron Co. to face prosecution under the state labor law forbidding such employment on public works construction. The finance committee of the common council has directed the corporation counsel to take steps necessary to prosecution after studying the report of an investigation made by the director of the employment division of the social welfare department. This is the first time that such a move has been made by the city since the adoption of the state law.

◆

Personal Notes

Lawrence W. Wallace, secretary, American Engineering Council, Washington, D. C., received the degree of doctor of engineering from Purdue University on June 14.

A. J. Faraon has joined the staff of the Blaw-Knox Co. as sales engineer for welded process equipment. Mr. Faraon is a graduate of Stevens Institute and in recent years has specialized in electrical welding.

Wm. P. McDonald, president of the Wm. P. McDonald Construction Co. and Job H. Lippincott, formerly vice-president of the Warren Brothers Co., have formed the McDonald International Corp., New York, to engage in highway and other contract work abroad. Chas. M. Upham, secretary of the American Road Builders Assn., is to be consulting engineer to the firm.

Walter E. Sullivan, chief sewer engineer, Cincinnati, Ohio, will retire from active service on Aug. 1. He will have completed 35 years of service this year. Mr. Sullivan began work with the city as a rodman in 1891 and in 1898 was made an assistant superintendent in the waterworks department and hydraulic engineer. Previous to 1914 he was out of the city service for a few years.

◆

Obituary

Robert A. Anderson, president, Gamon Meter Co., Newark, N. J., died on June 16.

Dudley G. Gimber, president of the Brown-King Construction Co. of Philadelphia, died at his summer home at Ocean City, N. J., on June 19. Mr. Gimber was 52 years old.

William F. Sheehan, 38 years of age, engineer for the town of Amherst and the village of Williamsville, N. Y., died June 14, at Warsaw, N. Y., from injuries sustained in an automobile accident. Mr. Sheehan was a graduate of Rensselaer Polytechnic Institute and also studied at Rutgers and the University of Buffalo.

Alexander Fraser, chief engineer, Roads Department, Province of Quebec, whose sudden death at the Laval-sur-le-Lac golf course near Montreal on June 11 was noted in last week's issue, was a native of Cap St. Ignace, Que., and a graduate from L'Ecole Polytechnique University of Montreal. He began his career as an assistant engineer on the St. Lawrence ship canal where he spent two years before entering the Quebec Road Department as an engineer on construction. Twelve years ago Mr. Fraser was made head of the department. In addition to his work in the highway department, Mr. Fraser served as professor of highway engineering and a director of the L'Ecole Polytechnique.

SOCIETY CALENDAR

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS, annual meeting, Ohio State University, Columbus, Ohio, June 20-23, 1932.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Yellowstone National Park, July 6-9.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, 40th annual meeting, Oregon State College, Corvallis, June 29-July 1.

NEW YORK STATE SEWAGE WORKS ASSOCIATION held its spring meeting in Buffalo, N. Y., June 10-11. The total registration was 130. Exhibits were displayed by 27 manufacturers. It was announced that the third short school for sewage-works operators would be held at Cornell University in April, 1933. Papers presented at the meeting included "The Design and Operation of Settling Tanks," by Clyde Potts; "Experiences in Remodeling a Sewage Treatment Works and in the Elimination of Excessive Ground Water Infiltration," by Harold J. Huber; and "Mechanical Equipment Employed in Recovering Sludge from Settling Tanks," by E. B. Besselievre.

WEST SHORE WATER PRODUCERS ASSOCIATION met June 15 in Chicago and heard the construction of the 16-ft Chicago Ave. water tunnel described by J. J. Versluis, engineer of water works construction. Work has recently been resumed with double shifts on this 10-mile bore, 4 miles under the lake and the remainder reaching westward to inland pumping stations. About $3,500,000 has been made available this year; a like amount next year will complete the work which has been under way several years. F. O. Tonney and Ralph E. Noble, Chicago Department of Health, demonstrated the new ferrocyanide citrate agar medium for B. Coli determination in 30 hours. As algae tastes and odors are just beginning to appear the July 20 meeting at Highland Park, Ill., will be devoted to the immediate experiences of the filter operators.

TO HONOR FRANK J. SPRAGUE on his 75th birthday, a meeting is to be held in the auditorium of the Engineering Societies building in New York on July 25. The meeting is sponsored by the major engineering societies of the country. Mr. Sprague's activities have been in electrical engineering. He is known as the "father of electric traction" and the inventor of the multiple-unit system by which two to four times the traffic capacity of tracks and terminals is realized, a system now widely used throughout the world.

ROCHESTER ENGINEERING SOCIETY, at its annual meeting held on June 9, elected Roe T. Soule president. Mr. Soule is technical engineer for the Taylor Instrument Co. Other officers elected were Philip F. Stephens and Frederick H. Evans as vice-presidents, Maynard D. Lee recording secretary, and Howard Harding, treasurer.

COLORADO ENGINEERING COUNCIL, at its annual meeting on June 9, elected Robert K. Fuller, an architect of Denver, as president, Charles W. Henderson, vice-president, and Ralph B. Hubbard, secretary-treasurer.

PHILADELPHIA SECTION, American Society of Civil Engineers, at its annual meeting held in that city on June 14, elected Clarence E. Myers, president, Charles B. Shaughnessy and Sanford W. Sawin, vice-presidents, and Charles A. Howland, secretary. George T. Seabury, secretary of the society, Frank Parker president of the Philadelphia Federation of Construction Industries, and J. W. Follin addressed the section.

Engineering Contracts and Capital

Contract awards reported for the past week total $14,689,000, the lowest since the week of March 10. The week's figures are $8,000,000 below the weekly average for the month. New capital issues reported, all public bonds, total $33,800,000.

New York Strike Ends—The general strike of building trades in New York City, called May 2, was settled June 16 with a compromise on the part of employers. Fifteen per cent reduction was agreed upon, instead of the 25 per cent demanded by the employers. The basic scale is $11.20 per day, with helpers receiving $8.25. Bricklayers are to get $13.20. About 130,000 men were involved in the strike, which is now estimated to have cost the construction industry over $10,000,000. The new agreements will be in effect until the end of 1933.

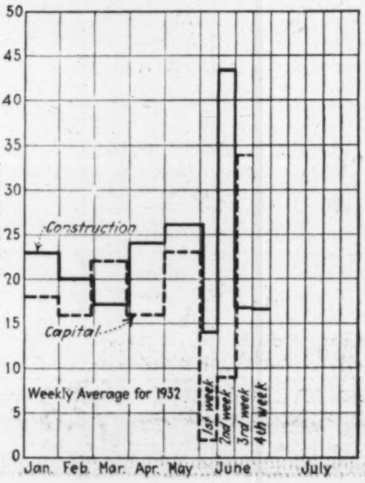
May Paving Yardage—The Portland Cement Association announces that a total of 10,359,684 sq.yd. of concrete paving was awarded during the month of May, bringing the total for the first five months of the year to 33,231,761 sq.yd. About 90 per cent of the yardage has been for roads, the other 10 per cent being streets and alleys.

Texas Wage Law Invalid — Labor statutes of Texas requiring contractors to pay prevailing wages on state work are held unconstitutional in a decision by three judges of the United States district court made June 14 at Austin. The decision was made in answer to an injunction sought by four contractors working on new buildings for the University of Texas restraining state officials from enforcing the statutes. More details are given on page 898.

Lumber Production Low—Reports from the National Lumber Manufacturers' Association show that lumber production for the week ended June 11 is but 40 per cent of a 3-year average, and that the same percentage holds true for production of the year to date.

Building Permits

According to reports from 50 representative cities, building permits for the month of May show a slight loss from the permits reported for April. Estimated permits for the entire country are $55,000,000 for May against $56,400,000 for April. The first five months of 1932 show figures totaling $263,000,000, estimated for the entire country, compared with permits totaling $703,700,000 for the same period last year.



BUILDING PERMIT FIGURES
(Thousands of dollars)

	Actual 50 Cities	Estimated Total for U.S.
May, 1931	$29,397	$107,700
May, 1932	15,008	55,000
Per cent loss, 52		
Five months, 1931	$192,014	$703,700
Five months, 1932	72,013	263,000
Per cent loss, 61		

Contracts and Capital

CONSTRUCTION
(Thousands of Dollars)

	Weekly June 1931	Average June 1932	Week June 23, 1932
Federal government	$5,039	$6,503	$1,099
State and municipal	26,395	11,242	11,156
Total public	31,434	17,745	12,255
Total private	17,647	4,854	2,434
Week's total	$49,081	$22,599	$14,689

Cumulative, Jan. 1 to date:

1931 construction	$1,385,622
1932 construction	544,719

Decrease, 61 per cent.

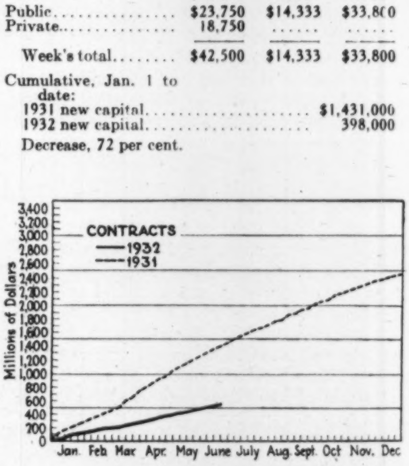
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

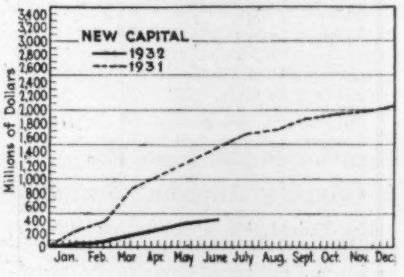
	Weekly June, 1931	Average June, 1932	Week, June 18, 193
Public	$23,750	$14,333	$33,800
Private	18,750	......	......
Week's total	$42,500	$14,333	$33,800

Cumulative, Jan. 1 to date:

1931 new capital	$1,431,000
1932 new capital	398,000

Decrease, 72 per cent.





ENR Cost and Volume Index

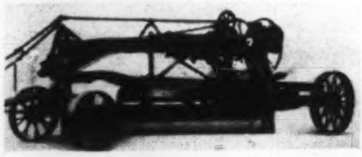
Cost		Volume	
June, 1932	**152.20**	**May, 1932**	**149**
May, 1932	152.78	April, 1932	135
June, 1931	187.21	May, 1931	251
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.45	1930 (Average)	260
1913 Average	100.00		

Construction Equipment and Materials

Leaning-Wheel Grader With 12-Ft. Blade

A new leaning-wheel grader carrying a 12-ft. blade is announced by the Caterpillar Tractor Co., Peoria, Ill. It is known as the Caterpillar Fifty grader. The lifting machanism is hand-wheel operated and is mounted on anti-friction bearings.

Caterpillar Fifty grader.



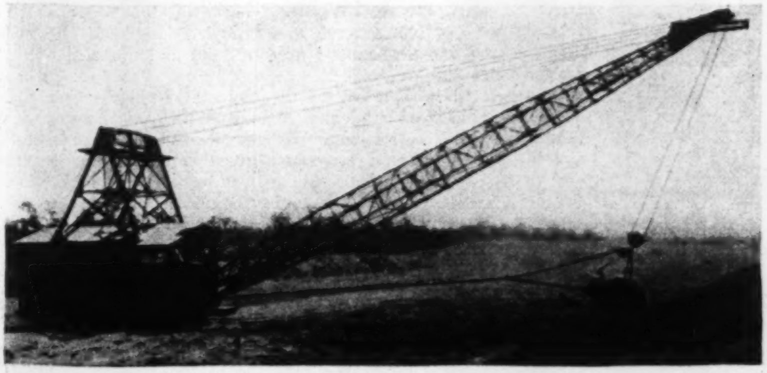
The lift-arm shaft and important forward parts are heat-treated. Axle spindles are of chrome-nickel treated steel. Compensating blade lift springs are provided.

◆

Large-Capacity Dragline for Levee Construction

The Bucyrus-Monighan Co. announces a large-capacity, long-boom dragline specially designed for the construction of river levees, designated as model 10-W. The standard boom length is 160 ft. with a 10-yd. bucket, or a 150-ft. boom with an 11-yd. bucket. The reach from the center of the base with the boom at an 18-deg. angle is 169 ft., and the operating radius, including the swing of the bucket beyond the end of the boom, is 200 ft. The height from the ground to the top of the A-frame is 60 ft. Under normal conditions the machine performs a cycle in about 70 sec. The total weight is about 675 tons, but due to the large area of the circular base on which it rests while working the specific pressure is low, enabling it to operate on comparatively soft ground. The machine is powered by a five-cylinder Fairbanks Morse diesel engine rated at 450 hp. at 257 r.p.m. Power for the loading and hoisting drums and the walking device is transmitted by belt, while the swinging and boom-raising mechanisms are motor-driven. The machine is fitted with patented Bucyrus-Monighan walking traction and takes a step 7½ ft. long.

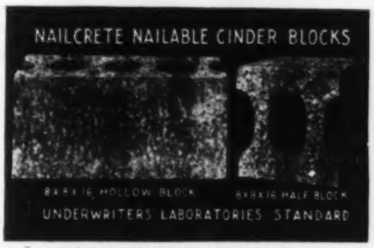
Bucyrus-Monighan walking dragline excavator.



◆

Nailable Cinder Block

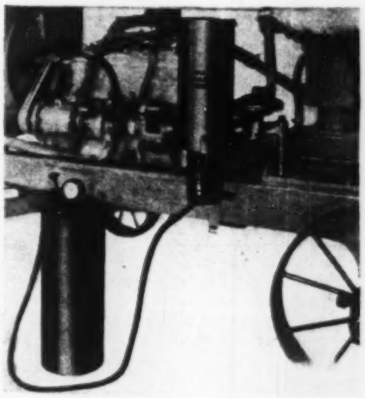
The Nailcrete Corp., 105 West 40th St., New York City, announces the Nailcrete nailable cinder block for building work. The new block is made of asbestos fiber in combination with cement, sand and cinders and is a nailable fireproof unit. It is steam-treated instead of burned and retains its shape as molded, the manufacturer states. The blocks were recently submitted to a test at the Underwriters' Laboratories in Chicago and have just been approved by the National Board of Fire Underwriters. "Certificated" blocks for walls or partitions can be furnished where this type is specified. It is claimed that the blocks will transmit less heat than the ordinary plain cinder blocks, and that with the asbestos content sound transmission through walls and floors is largely eliminated.


NAILCRETE NAILABLE CINDER BLOCKS
8X8X16 HOLLOW BLOCK
8X8X16 HALF BLOCK
UNDERWRITERS' LABORATORIES STANDARD

◆

Gas-Engine Heater

A new device for supplying heat to an internal combustion engine to make starting easy in cold weather has been introduced by the Sullivan Machinery Co., Chicago, Ill. The new piece of equipment is known as the Start-O-Heater. It consists primarily of an oversize heating coil to which a simple diaphragm pump is connected. The discharge side of the coil is connected to the inlet of the cooling circuit of the engine, and the inlet side is connected to the cooling water discharge. Heat is supplied by any gasoline torch or thawer. When the engine starts, the pressure from the regular circulating water pump closes the valves in the heater element, and normal circulation of the cooling water is not disturbed. The new device is intended primarily for use on Sullivan compressors, but the manufacturer states that it can be adapted for use on any make of portable compressor or on any type of gasoline-driven equipment.



Sullivan Machinery Co.'s heater for easy starting of gasoline engines.

◆

Business Notes

American Cable Co. announces that the Wickwire Spencer Steel Corp. has recently been added to the list of wire-rope manufacturers licensed to manufacture preformed wire rope under the American Cable Co.'s patents. Other companies in the United States who are licensed to make preformed wire rope are: American Steel & Wire Co., Broderick & Bascom Co., E. H. Edwards Co., Hazard Wire Rope Co., Macwhyte Co., Pacific Wire Rope Co., General Cable Corp., and the Wire Rope Manufacturing & Equipment Co.

George P. Nichols & Bros., Chicago, Ill., have acquired all the physical assets, equipment, patents and good will of Stearns-Stafford Roller Bearing Co., Lawton, Mich., and will carry on the manufacture and sale of that company's products through the Stearns-Stafford roller-bearing division of the George P. Nichols & Bros., Inc. The Nichols organization dates back to 1894, when a partnership was formed between George P. and Samuel F. Nichols, the partnership continuing until 1928, when George P. Nichols retired on account of ill health. The organization began the manufacture of transfer tables and electric turntable tractors in 1900.

Bureau of Standards, Department of Commerce, announces that under date of March 5 a recommended revision of the Commercial Standard for diamond core-drill fittings was circulated for written acceptance. Since that time signed acceptances have been received from a number of manufacturers and users estimated to represent a satisfactory majority. It is announced, therefore, that the commercial standard may be considered effective for new production and clearance of existing stocks as of Aug. 15, 1932. A booklet covering this commercial standard will soon be available.

Peerless-Union Explosives Corp. has been merged with the Atlas-Powder Co., of Wilmington, Del., and all plants and business are now being handled by the Atlas Co,

Norma - Hoffmann Bearings Corp., Stamford, Conn., announces that H. J. Ritter, assistant secretary, has also been made sales manager of the organization.

Current Construction Unit Prices

San Gabriel Dam No. 2, California

SAN GABRIEL DAM NO. 2 of the Los Angeles County flood-control project, on the West Fork of the San Gabriel River 22 miles from the city of Azusa, is of the rockfill type, 245 ft. high with an 800-ft. base and crest length of 580 ft. Bids were first taken Feb. 8, 1932, and the Merritt-Chapman & Scott Corp. bids of $1,686,464 on proposal 1 for a dam with a poured concrete facing and $1,690,264 for gunite concrete facing were low by $452,396 and $432,196 respectively. The low bidder refused to sign the contract and new bids were taken March 21, 1932. Contract was awarded on a joint low bid of $2,086,950 on proposal 2 by the Macco Construction Co., Hynes, Calif., and Lewis Construction Co., Los Angeles. Total bids submitted on this proposal at the two openings are given below.

	Feb. 3	March 21
Merritt-Chapman & Scott	$1,690,264	....
Macco-Lewis	2,122,460	$2,086,950
Bent Bros.	2,323,180	2,462,780
Utah Construction Co.	2,517,945	2,441,970
L. E. Dixon-Hall-Johnson	2,528,150	2,221,100
George Pollock	2,757,945	2,459,320
W. E. Callahan	2,918,975	....
T. E. Connolly	....	2,514,165
Average	$2,408,000	$2,364,000
Engineer's estimate	$2,917,520	$2,917,520

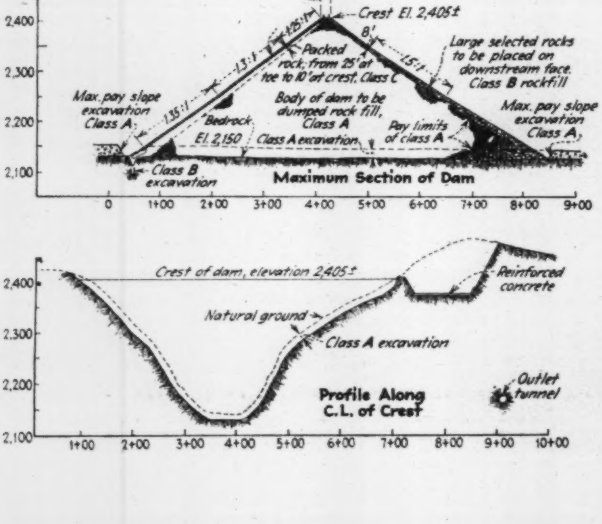
A public road extends from Azusa to the junction of West and North forks of the West Fork of the San Gabriel River, and a construction road has been constructed by the Los Angeles County flood-control district from the North Fork to the damsite.

Contract covers building the dam and protecting it with a gunite facing. An open spillway will be excavated through the hill south of the dam and lined with reinforced concrete. Outlets will be provided by tunnels driven through the south abutment. The main outlet tunnel is being driven under a separate contract.

Type of facing is the only difference between the two proposals. On the 500,000 sq.ft. of slabs required for the upstream face the contract price was 16c. and the average of the six bids 18c. On the 440,000 sq.ft. of gunite contract price was 18c. and the average 23c. Thus the average difference in cost between the two types was $9,867 in favor of poured slabs. The successful contractor's bid, however, figures $800 less for gunite facing, and contract was awarded on proposal 2 calling for this facing.

The largest items of course cover excavation and rockfill, totaling $1,659,375, or 80 per cent of the contract price. Class A rock for general use throughout the main fill of the dam consists of 40 per cent quarry chips to 1,000-lb. pieces, 30 per cent up to 3,000-lb., 30 per cent up to 14,000-lb., and the greatest dimension of any piece must not be more than four times its least dimension. Class B, for heavy cover on downstream slope at toe is 6,000 lb. or more; Class C, up to 14,000 lb.

Maximum section of San Gabriel Dam No. 2 and profile along center line of crest.



Concrete items total 24,500 cu.yd. at $209,050. In addition there is the 440,000 sq.ft. of 1 : 5½ gunite shot in 6-in. layers in which reinforcing steel is embedded.

In compliance with the prevailing wage law, minimum wages have been set ranging from $4 per day for common labor to $10 per day for dragline operators.

Unit prices are given of the lowest two bidders, (A) Macco-Lewis; (B) L. E. Dixon and Hall Johnson, and (C) of the Merritt-Chapman & Scott low bid submitted at the Feb. 8 opening. E. C. Eaton is chief engineer of the district.

	A	B	C
Excav., class A open-cut for foundation, 250,000 cu.yd.	$0.75	$0.65	$0.60
Excav., class B cutoff trenches, 7,200 cu.yd.	5.00	9.00	3.00
Excav., class C all except A & B, 180,000 cu.yd.	1.25	1.75	.55
Outlet tunnels driving, 1,000 cu.yd.	15.00	15.00	10.00
Rockfill, class A dumped in body of dam, 970,000 cu.yd.	1.00	1.00	.81
Rockfill, class B large selected rock, 95,000 cu.yd.	1.30	1.25	.85
Rockfill, class C packed rock, 52,500 cu.yd.	1.95	3.50	1.65
Conc., class A upstream cutoff, 8,000 cu.yd.	5.20	5.00	5.40
Conc., class B all other plain concrete, 6,500 cu.yd.	8.30	7.00	5.60
Conc., class C reinforced conc. 8,000 cu.yd.	10.00	9.70	8.40
Conc., class D tunnel lining, 2,000 cu.yd.	16.77	20.00	19.00
Conc. facing slab, 500,000 sq.ft.	.16	.14	.23
Gunite facing slab, 440,000 sq.ft.	.18	.12	.27
Grout holes, class A less than 10 ft. deep, 3,000 lin.ft.	.40	.50	.50
Grout holes, class B from 10 ft. to 50 ft. deep, 7,500 lin.ft.	.70	1.50	1.24
Grout holes, class C from 50 to 150 ft. deep, 20,000 lin.ft.	2.25	2.25	3.20
Grout holes, class D redrilling through grout, 7,500 lin.ft.	.90	1.00	1.25
Grout holes, class E in tunnel less than 20 ft., 12,000 lin.ft.	1.00	1.00	.80
Placing fittings on grout holes, 1,700 holes	.80	.50	.50
Grout pipe placing, 1,300 lin.ft.	.25	1.00	.08
Grouting under pressure, 500 cu.yd.	42.00	25.00	24.00
Water seals placing, 14,000 lin.ft.	.25	.30	.14
Gates and valves placing, 275,000 lb.	.02	.03	.04
Operating pipes and steel vent pipes, 50,000 lb.	.025	.02	.04
Trash racks, tank and structural steel, 100,000 lb.	.02	.02	.04
Reinforcing steel placing, 200,000 lb.	015	.02	.0125
Iron pipe hand rail placing, 6,000 lb.	.10	.05	.05
Tile drains placing, 1,500 lin.ft.	.45	.20	.10
Steel dowels placing, 4,500 lin.ft.	.75	.10	.30
Backfill all types, 500 cu.yd.	2.00	1.00	1.00
Furnishing lodging to district employees, 15,000 man nights	.30	.30	.15
Furnishing meals to district employees, 15,000 man days	1.40	1.20	1.35
Totals (proposal 2)	$2,086,950	$2,221,100	$1,690,264

* * *

Highway and Bridge Work in Washington State*

TWO contracts were let in February, 1932, for work on lateral highway 3 and permanent highway 10 in Pend Oreille County, Wash. Work on highway 3 includes a steel truss bridge on four concrete piers; and on highway 10, grading, draining and graveling 1 mile of road and the construction of a wooden bridge.

Contracts were awarded to the Colonial Building Co., Spokane, for $14,727 on highway 10 and $49,141 on highway 3, a total of $63,868. Bids were received from twelve contractors, and the lowest six unit prices are given in their order on several of the items on which bidding was particularly close. J. C. Stegner, Newport, Wash., is county engineer.

5,740 cu.yd. common excav.	$0.20	$0.22	$0.25†	$0.25	$0.25	$0.25
100 cu.yd. loose rock	.25	.35†	.40	.40	.40	.50
3,600 lin.ft. piling	.29	.30	.30	.30	.32	.33
1,163 cu.yd. concrete	14.00†	14.00	14.00	14.00	14.50	14.50
40.700 lb. reinf. steel	.045	.045	.045	.0475	.05†	.05
474,000 lb. structural steel	.055	.056†	.057	.0575	.06	.06
204 M ft. b.m. timber	40.00	40.00	40.00	41.00†	42.00	44.00

†Contract prices; piling, $0.35 per linear feet.